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CASPAR WHITNEY

GUNS, AMMUNITION, AND TACKLE

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1
2
3
4
5
6
7
8
9
10
11
12

GUNS, AMMUNITION, AND TACKLE

BY

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WITH MANY ILLUSTRATIONS

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CONTENTS

THE SHOT-GUN AND ITS HANDLING

By Captain A. W. Money

THE HUNTING RIFLE

By Horace Kephart

THE ARTIFICIAL FLY

By John Harrington Keene

ILLUSTRATIONS

THE SHOT-GUN AND ITS HANDLING

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THE SHOT-GUN AND ITS HANDLING

Conduct in the Field

America stands above all others in the world as a game-producing country. Both climate and soil are just what suit the numerous varieties found in such abundance. It is not, therefore, surprising that it should also produce the greatest number of shooters and the best shots; there is no doubt that, in proportion to population, the game-shooters of America largely outnumber those of any other country, England included. It is equally true that they are, as a rule, better shots, use better guns and better ammunition, and have a far more thorough acquaintance with all that concerns guns, ammunition, habits of game, and how to shoot, than their brother sportsmen in other countries.

The reason for this is not hard to find.

Apart from the natural tendency of an American to excel at anything he takes in hand,

whether as an amusement or as a business, there are other strong reasons why he should take up shooting in the first instance, and why, having done so, he may and should shoot well.

In most other countries shooting is an expensive amusement, and confined to the wealthier part of the population, partly on account of the government tax which is levied on the use of the gun, even if not used on game, — the game-tax being still heavier; partly, and chiefly, because game-preserving is carried on to such an extent in those countries that without committing a trespass the non-owner or non-occupier of land cannot, as a rule, find anything to shoot at; and lastly, because the scale of wages and salaries in those countries is so low that no one but the wealthy classes has any money or time to spend on shooting.

In America, on the contrary, there is no tax to stop a man from owning or using a gun; and if he wishes to go after game, he can do so quite easily at present, without trespassing; whilst throughout the whole country, salaries and wages run high enough to enable a man to spend something on shooting, or any other amusement he fancies.

Probably of all others, however, the strongest

reason is the facility with which shooting of some kind or another, good, bad, or indifferent, can be obtained by practically every gunner in America, and the great variety of game the sportsman can pursue. For instance, duck, quail, geese, prairie-chicken, ruffed grouse, woodcock, snipe, rail-birds, rabbits, etc., tempt old and young alike, and afford a great variety of sport.

Another reason why Americans should be ardent sportsmen is because North America is, *par excellence*, the country for camping. And who would ever camp out without a gun of some sort or another? — it seems to be so essentially a part of the outfit.

Reader, have you ever camped out on a shooting trip? If you have not, you have missed something that is too good to be missed; something the memory of which in later days will never entirely die out. I don't mean occupying a fixed camp, with a built-up log-cabin and every luxury, but your own moving and movable camp.

Nowhere on the face of the globe are all the conditions so favorable to this nomadic kind of life as they are in most parts of this continent. Are you an invalid? Try camping out, and see if you don't say good-by to all the doctor's

stuff. Are you brain weary and tired out from business? Only try it once, and you will never regret and never forget it. Go to the mountains for choice; but camping anywhere, especially if you are already a sportsman and can combine shooting and perhaps fishing with the camping out, has to ninety-nine people out of a hundred a fascination all its own. You go into camp with a jaded appetite and wanting all sorts of delicacies to tempt it. After a few days you wonder how you ever can have required those rich sauces and fine cooking and one course after another.

Appetite! You never knew the meaning of the word before. And the way you sleep! Off like a top almost before your head is on its pillow, whatever that may be. Awake, yes, wide awake at daylight, and wondering how on earth you have lived so long and never known the beauties and enjoyment to be seen and felt at that hour.

Up and busy about camp breakfast, and then off for a day's shooting, — duck on the river or lake, quail in the fields, ruffed grouse in the bush and on the hills.

Companions, yes; and if he or they are congenial, this is when companionships and friendships are made that last a lifetime. But if you are a

true sportsman, with all the sporting instinct strong in you, your dog is the one companion you need most, provided you have the right sort.

You and he are going to work all day together, he to find the game, you to shoot it.

Your eye is never off him for many moments at a time; and as you realize how hard he is working to give you sport, you forget he is only a poor devil of a dog, and begin to look upon him, and talk to him too, as a companion, — and don't imagine he won't appreciate it.

There is much to be said on behalf of every branch of shooting; but for real, downright, true sport, what can compare with a day at ruffed grouse on the Jersey or Pennsylvania hills, with a good dog and a good companion? I have tried them all, not only in this country, but in England, Scotland, and Wales. Geese, ducks, quail, woodcock, snipe, the red grouse of the Scotch moors, pheasants, and partridges, — each gives one the pleasure which all keen sportsmen feel; but to my mind not one of them quite comes up to the pursuit of that most game and wily bird, the ruffed grouse.

You cannot make a heavy bag of them, it is true, but every one you do put into your pocket has a story of its own; and when you stop to eat your

luncheon and lay several of these beauties before you, you look at them as so many individual heads of game, and not as one morning's bag. Each one has cost you a hard tramp, and given you, and your dog also, much pleasure and excitement before you succeeded in laying it low.

Then, too, when they rise, what an exhilarating sound, that heavy whir of the wings; and what wonderful cleverness they show in putting a branch, a trunk of a tree, — something, anything, — between themselves and the gun they seem to know by instinct is pointing at them! But though I am personally fond of shooting ruffed grouse, I am well aware that many who are as good or better sportsmen than myself prefer shooting quail, prairie-chicken, wild fowl, snipe, etc.; and each of these with its varying surroundings has its own especial charm.

Quail shooting, like prairie-chicken shooting, is nothing without good ranging dogs, either setters or pointers; and the true sportsman takes as much interest in watching his dogs' work as in his own performance with the gun.

But we are at this moment more interested in the gun than the dog, and we will suppose that the reader is about to start on a day's quail shoot-

ing; and being somewhat of a novice, he wants a few hints as to what he should do or what he should not do.

Your gun should be of medium weight, both barrels cylinder bored; your shells lightly loaded as to powder, and with not more than one ounce of shot, — No. 8 for choice.

You are now in the field, and your first, last, and ever present thought should be, to do nothing that can by any possibility imperil the lives of your companions.

You have in your hand a dangerous weapon; and accidents occur so quickly, and in such unthought-of ways, that it is impossible to be overcautious. I am not exaggerating; and if you had been shot by careless companions as many times as I have, and seen as many serious, and in two cases fatal, accidents, as I have, you would feel about it as I do.

If you are a novice with a gun, keep as much as possible on the left side of whoever is with you. Your gun will then most likely be pointing into vacant space, as it is usually, when expecting game, carried across the body, pointing to the left; and if by chance it goes off without your intending that it should, you will hit no one.

On the other hand, if you study your own safety chiefly, or have a novice for a companion, keep on his right side. Be most careful, at all times, that your gun is not pointing at or near any human being, but especially so when in the act of closing it. Never get over a fence without taking out both shells; it is the only safe way; and never, after laying your gun down, resting it against a tree, etc., draw it toward you by the muzzle. This has been the cause of many a fatal accident.

Make it a rule never to fire at anything unless you are *sure* that there is no person within range, or in or near the line of the object you wish to shoot at. Let any amount of game escape sooner than run the slightest risk of blinding, maiming, or killing a human being.

If you see others handling or carrying their guns carelessly, call their attention to it. This can always be done in a way that will not give offence; and it not only makes them and the other members of the party more careful, but will help you to be more careful yourself.

Having been myself shot very seriously in both legs, when quite a boy, by a careless companion, I have always been most careful to run no risk of

shooting others, and cannot blame myself in any way for the three men and two boys that I have put shot into since my own accident, as in every one of these five instances the shot ricochetted, — in one instance off the ground; in another, off the hinge of a door; and in the other three, off branches of trees, at such angles as no one would have thought possible.

I mention this to show that when, with every precaution, such accidents will still happen, the chances of their occurrence must be enormously increased when there is the slightest carelessness.

When carrying a loaded gun, whether you are expecting game to spring or not, never put your finger on the trigger until you put the gun to your shoulder.

When carrying the gun over your shoulder, always have the trigger guard upward; otherwise any one walking behind you will have his head in a line with your muzzle every now and then.

When game rises, study to be quick, and yet deliberate; shoot quickly, and yet not over-hurriedly; never show yourself too greedy to get all the shots, even if you feel that way.

There is an unwritten law about leaving shots to your companion, which should always be strictly

followed: this is, that a single bird rising in front of a shooter is his to shoot at until he has missed it, when the next man is at liberty to kill it if he can. If more than one bird rises, the shooter on the right should shoot at the right-hand birds, leaving the left-hand ones to the gun on his left, and *vice versa.*

Remember that sport in shooting is not confined to the mere fact of shooting at and killing or missing your game, apart from handling or watching others handle the dogs, and watching the dogs themselves at their work. There is also what may be termed the science of woodcraft belonging to it, which no book can teach, but which every true sportsman will learn for himself as speedily as possible.

This will teach you where game should be found at different times of the day, even on ground you have never visited before; where a flushed covey is likely to have flown to, though you have been unable to mark them down; it will make you get into the instinctive habit of counting the number of birds in a covey as they flush, so that you can tell later whether you have found them all after they have scattered, as quail usually do, after being flushed; it will save your tramping

over miles of ground where the birds are not, and tiring yourself and your dogs for nothing; it will teach you the length of flight which each kind of game is likely to take after being flushed, so that you can follow it up and spring it again.

This naturally varies with the season of the year, the nature of the ground, as well as the description of game you are in pursuit of. Thus, for instance, a woodcock will usually light again within one hundred yards of where it first sprung, a ruffed grouse within three hundred, quail within, say, two hundred. Ruffed grouse will almost always continue in the same straight line they first started on till the moment of lighting, whilst the flight of quail and woodcock varies in any direction.

All varieties of game, whether winged or four-footed, are more alarmed by a person walking straight toward them than if they are approached by a circling, sideways movement.

When game is wild, and it is difficult to get within shot of it, bear this fact in mind; and, when your dog begins to make game, in place of following him up, make a détour, circling round where you imagine the game to be, and trying to get it between yourself and your dog. You will in this

way often get a shot where it would have been hopeless otherwise.

It does not often happen, except perhaps in the case of wild-fowl shooting, that you have to stalk your game; but if you ever have to do so, bear in mind that nothing catches the eye of any wild animal so quickly as the human eye. And when trying to see where the object you are in pursuit of is located, look through a fringe of grass, or if that is not possible, through half-closed eyelids.

Don't be persuaded to go out too early. You will gain nothing by it in the long run. Let the birds have their early morning feed in peace, and at eight, or better nine, o'clock, you will find them lying, sunning and dusting themselves, in their accustomed spot, prepared to lie well to your dogs and give you plenty of sport.

It is all very well for a pot-hunter, who wants to shoot as many birds as he can, to be out at daylight and work till dark, but this is not sport.

Nothing alarms all kinds of game so much as the human voice; therefore avoid talking, and especially loud talking or shouting, while you are looking for game. Carry a whistle in such a position that you can get at it quickly. This will not alarm game to anything like the same extent as

the voice. It is a good plan to arrange with your companions a series of simple calls, such as *one* sharp whistle, meaning, "Where are you?" *two*, meaning, "I am coming to you"; *three*, meaning, "Come to me."

As to dress, be sure that you wear wool next your skin, from your neck downward, — heavy or light according to the season of the year, — unless you wish later on to suffer from malaria or rheumatism, or both.

Nothing spoils a man's sport so much as a chafed or blistered heel; therefore be careful that your socks or stockings, as the case may be, fit well and are not so loose as to rumple up in folds, and yet are of proper thickness to guard the feet from any slight unevenness in the boot or shoe, which must also be well fitting, and have soles sufficiently thick to prevent your feet feeling the inequalities of the ground, and so getting bruised.

Canvas shooting-clothes, as sold by all sporting-goods dealers, are the best for outside wear, as they resist thorns, — of which you will come across plenty; and the prickly burrs, which in several varieties flourish on all ground that quail frequent, will not adhere to them as they will to any kind of cloth garment.

Your hat should have a wide brim, so that the eyes may be shaded from the sun, especially when it is getting low as the afternoon progresses.

In shooting, eyesight is more than half the battle; and if a man's eyes are defective, he cannot hope to shoot as well as if this were not the case. He can probably improve matters very much by wearing glasses; and a man soon becomes accustomed to shooting in them, and except in wet weather is not handicapped by their use to any great extent. If the left eye is more powerful than the right, the only real remedy is a pair of properly adjusted glasses.

Several mechanical contrivances have been made which were affixed to the barrels and were supposed to remedy this defect, but none of them have proved successful.

If a man, however, shoots with both eyes wide open and does not attempt to aim, but fires instinctively as soon as he throws the gun to his shoulder, he will find that, despite the inequality in the sight of his two eyes, he yet points his gun at the right spot.

English and American Shooting Compared

A comparison between American and English shooting will perhaps be interesting to many who know only the one or the other. The difference between the two sports is, however, so great that it is hard to know just where to begin.

I have had exceptional opportunities for enjoying sport in both countries, having shot all over England and Scotland, as well as having had a long and extended experience of all forms of American shooting. In England shooting may be divided practically under three heads, — grouse shooting, partridge shooting, and pheasant shooting. There is a little wild-fowl shooting, chiefly around the coast, but it does not amount to much compared with what there is in America; while snipe, woodcock, and ground-game — *i.e.* hares and rabbits — come in as incidentals when shooting the game mentioned under one of the three above heads. The same may be said of black game, — ptarmigan, plover, curlew, and wood-pigeons, — all of which are occasionally met with, and help to vary the day's bag.

The open season on grouse commences on the 12th of August, and closes on December 10th.

Grouse are only to be found on the moors,—that is, on uncultivated land covered with heather or fern, —or in cultivated fields adjoining these moors. Every bit of land on which grouse are found, as well as practically every bit of land throughout the country, is strictly preserved and guarded, and poachers, as a very general rule, meet with prompt and condign punishment.

Most of the moors in Scotland and in the north of England are rented, and a stipulation is made in each lease that only a certain specified number of grouse can be killed during the season by the lessee. The amount paid as rental for a moor varies according to different localities and their proximity to or distance from railroads or steamship communication. The rental usually includes the use of a shooting-box (termed, as a rule, "lodge") of very varying size and comfort, also of dogs and keepers, according to the extent of the moor. In fixing this rental it is usual to estimate its value at the rate of one pound sterling (about five dollars) for each brace of grouse allowed to be killed on the moor. I say "allowed to be killed," because it frequently happens that the lessee finds himself entirely unable to kill even one-half of the allowed number, because the birds

are not there. There is as much roguery about letting moors as there is about selling horses, and the agent's word should never be taken; only a visit to the moor itself, or reliable information obtained on the spot, will make it safe to assume that you are probably going to get the value of your money.

On the other hand, occasionally moors are to be obtained where many more than the stipulated quantity of birds could be shot, and yet a sufficient stock left for the next season's breeding. I remember one such moor in the wilds of Ross-shire. It had never before been leased by its owner. I was invited by the gentleman, an Englishman, who had been fortunate enough to secure it for that season, to make one of a party of six guns to go up and shoot on the opening and eight following days, one Sunday intervening. The rental paid in this instance was one thousand pounds, equal to about five thousand dollars. We found a large, roomy, well-furnished, old-fashioned Scotch shooting-box, with ample accommodation for our party, which included several ladies, who were not shooters themselves, but who used to join us in a sumptuous champagne lunch, with *pâté de foie gras* and all the delicacies of the season, at some cosey

nook on the moor beside a brawling trout stream, of which there were several full of speckled beauties. We went out daily in two separate parties, starting about 9 A.M., and getting back to the lodge before dark, three guns in each party, and working in entirely different directions, each shooter having a loader with him carrying his second gun, ready to hand him whenever wanted, and two brace of dogs accompanying each party, as well as keepers, gillies, and ponies to carry out the luncheon and spare ammunition and to take home the game. The bag each day was usually from 150 to 200 brace of grouse. Hares were plentiful, but not considered worth shooting, as the Scotch mountain hare is very poor meat, being dry and stringy.

The scenery was magnificent and cover plentiful for the birds, but for some reason the scent was very bad or our bags would have been much larger.

At the end of our stay the head keeper told us that there was good ground left that we had not been upon, and we really seemed not to have lessened the number of grouse on that moor at all. In some parts of Scotland, and especially in the north of England, where grouse are most plentiful,

it is useless to try and shoot them over dogs. They are as difficult to get at as prairie-chickens after they have packed, and rise far out of shot.

On these moors, therefore, the only way in which grouse are ever shot is by driving the birds over the shooters' heads. There are other moors where grouse will lie to dogs only at the beginning of the season. Later you must drive them, or leave them alone.

On some moors the sportsmen only drive the birds, preferring that kind of shooting to walking and shooting to dogs, for any one of the following three reasons or for all three: 1st. That shooting driven grouse is much more difficult than shooting them over dogs. 2d. That if a man cannot spare much time for shooting, he can kill more in two days' driving than he could in several days' shooting over dogs. 3d. That walking up grouse is, even on the easiest moors, hard work, and on some rough, hilly moors very hard work indeed — sometimes a blazing sun, sometimes wet to the skin, almost always with feet wet when you come to a boggy part, which is frequently. This is work that an elderly or a stout or a sickly man does not care to encounter; whereas, in driving, he can ride a pony to the spot where he takes his

stand, and here, until the drive is over, he can keep well wrapped up and have dry feet, and even sit down all the time if so inclined; and he does not spoil any other person's sport, as would be the case if he were lagging behind and keeping the party waiting on a stiff bit of ground.

On the first of September partridge shooting commences.

Grouse shooting is almost entirely confined to the wealthier classes, but all classes except the daily laborer, who can never afford to fire a gun in a country where the agricultural rate of wages is as low as it is in England, try to have a few days' partridge shooting, and great is the banging all over the country on the first of September.

The weather is then usually hot, and the broods of partridges are easily driven, even if they have not already gone there of their own accord, to fields where there is not only shade from the sun but also cover from all enemies. These are chiefly fields of root crops, such as turnips, mangel-wurzel, or carrots, which are grown as food for cattle and sheep during the winter. Of course there are occasionally at the commencement of the shooting season, especially in the northern parts of Great Britain, fields here and there of grain, such as

wheat, oats, and barley, still uncut. This happens when the summer has been wet and cold and the grain late in ripening, for it must be remembered that the cereals grown in England and in Scotland do not ripen with the same rapidity that they do in this country, but of course one would not think of following partridges into standing wheat, barley, or oats. Times in England are hard enough for the farmers without having their crops trodden down by shooters and their attendants.

When I was a boy partridge shooting was as different as possible from what it is now. In those days the scythe was used on all cereal crops, leaving the stubble on the field knee high, and affording splendid cover for game of all sorts. Then setters or pointers were always kept and made use of; now very seldom indeed. The reaping machines introduced in late years leave the stubble fields as bare as a lawn. These must be walked over, for it is in them that the birds get their food, grain that is left on the ground and young clover forming quite a proportion of the partridge's diet. While the birds are on such stubble one rarely gets a shot until they have been driven to cover of another sort. Occasionally beaters are sent out to walk the stubbles and drive the birds

to cover before the shooting party arrives, but the rule is that the entire party do this work themselves.

Partridge driving is day by day growing more the custom, but where this is done it is rare for the partridges to be disturbed at all until well on in October, when all the latest broods are full grown and strong on the wing.

The other way of shooting them is to form a line as you go into each field, with intervals between the shooters, loaders with second guns (when they are used), and the keepers with retrievers following close behind. This line never stops until the field is worked out, keepers and their assistants, both biped and quadruped, marking where each bird falls and picking it up as the line passes the spot. As each man shoots he either takes his other gun from his loader without a pause or reloads as he moves on, keeping his place in the line. This line is under the direction of one man, usually the head keeper, who wheels it first one way and then the other, like a regiment of soldiers, so that each part of the field they are then in is walked over and the birds put up.

The use of pointers and setters in English shooting of to-day is chiefly confined to wilder parts of the country where there is rough shoot-

ing and where the coveys of birds are few and far between.

On the first of October pheasant shooting commences legally, and from then on pheasants can always be found in the market, but as the leaf has not then begun to fall and the birds have not got their full growth and plumage, few people allow them to be shot or care to shoot them until later in the year when the leaf is off.

Pheasant shooting nowadays is all driving. The guns, who may number anything, from four to eight as a rule, are placed forward at both sides and at the end of the wood or piece of wood which is to be beaten. A small army of men, each furnished with a good ash stick with which to tap on the trees in order to make a noise and on the brambles and bushes in order to drive out the game crouching under them, advance in a regular line toward the shooters, driving everything before them. Everything here means first and foremost pheasants, then hares, rabbits, and an occasional woodcock.

The majority of the pheasants prefer running on ahead of the line of beaters till they realize that they can get no farther, when they usually rush wildly about, getting more and more alarmed

each moment, till the near approach of the beaters forces them to rise, when they dash out in a headlong flight, twisting and rising high, or rocketing, as it is called, in their endeavor to avoid the guns below, and giving much harder shooting than the same birds would have furnished had they been put up by dogs or walked up quietly by a few persons going through the cover. Of course they do not all run forward, but now and again an occasional bird rises and seeks safety and quiet ahead of the beaters. Pheasants will seldom fly back if the line is well kept.

I think I am right in saying that the greater number of pheasants shot in England have been reared by hand. To the uninitiated, this would imply that these so-called tame birds would differ materially from those hatched out and brought up by the hen pheasant herself, but experience shows this not to be the case, and he would be a clever man indeed who could ever detect any difference, either in appearance or in the flight, when once well on the wing, of the wild or hand-reared birds. As the guns are always placed some distance from the cover, no birds are consequently shot at until they are well on the wing.

Pheasants are so loath to fly unless they are compelled to do so, and are so prone to running from one part of the cover to another, that it is usually necessary, especially in large woods, to have a number of boys stand in line at the sides to head off these running birds, and thus keep them in front of the line of beaters. These boys have a pair of sticks, one in each hand, which they keep tapping together the whole time, until the drive is over. The technical term for boys so employed is "stops."

There are many reasons why it is necessary to bring up pheasants by hand, *i.e.* to place the eggs under hens, and afterward to let them run with their foster mothers until they are fully grown and can fend for themselves. These are, first, that you could never get what is nowadays called a properly stocked covert from wild reared birds alone; they would stray away elsewhere, to seek some spot for their nest where they had not so much company in the shape of others of their own kind. Secondly, pheasants are very fond of nesting in a growing crop of grass, clover, etc., which would have to be cut before the young birds were out of the nests, and numberless eggs and chicks would be destroyed by the

mowing machine. Thirdly, the pheasant appears to take pleasure in making her nest near a foot-path or road, or wherever she is most likely to be disturbed and driven off, or to have the eggs carried off by poachers, children, dogs, etc.

For these reasons it is usual on estates to have keepers and helpers on the lookout for nests, who, as soon as they find one with its complement of eggs, take the latter to the hennery, where a supply of hens, anxious to sit, are kept in stock for the purpose of hatching the pheasant eggs. It is commonly estimated that one pound represents the cost of a pheasant to the owner of an estate, by the time it is shot, where there is strict preserving; this includes rearing, feeding, watching night and day, and all the incidental expenses connected with the keeping up of a good head of game on the property.

No bird is so easy to poach as a pheasant. He roosts at night, not very high, on a larch tree for choice, and the cock birds, when ascending to roost, proclaim to the whole neighborhood, in most unmistakable terms, just where they and their hens can be found. A number roost on the same tree, like barn-door fowl, where, on

anything but a dark night, it is easy to see their large bodies outlined against the sky.

What a different state of things prevails in America. When you feel inclined to go out shooting, you do not have to take out a license, and you do not need to wait until some friend asks you to make one of his party, and that probably for one day only. You are not limited to shooting in just this or that one spot, but can take your choice, and go north, south, east, or west, as fancy or the prospect of game tempts you. There is a delightful freedom about it all that immensely increases the enjoyment. Then, perhaps, also you are camping out, with all the charms of that sort of life.

You do not have to study your dress very particularly, as long as it is workmanlike and fit for the season of the year, and no one will criticise what you have on, especially if it looks as if it already had done good service. Again, you are shooting at game that has all the charm of being absolutely wild, not brought up in coops and fed by hand; not counted over every day by the keeper to see if any tom-cat or fox prowling round has made a meal of some of them. Others are free to shoot them as well as yourself, and

you have the incentive of wishing to get your share.

You may, if you do not know the ground well, perhaps take a guide with you, but you can do as you choose, whereas in England you must do as you are told. There you do not handle your own dogs; you do not, usually, where there is what is called "good shooting," load your own gun, or carry it, except when you expect a shot. You pay some one else to do all this for you, and, unless you are on your own property, you have no choice, but must do as the others do. Even as to dress, it must not be too much worn, or too much soiled, but you must appear very much as you would if going into ladies' society at a golf club. And who ever heard, in England, of having a shooting-coat with pockets for carrying your game.

All shooting has a charm about it to a sportsman, and I am not saying that I have not had the keenest enjoyment out of many a day in England with the gun, but to my mind it does not, and never has, compared with shooting where there is nothing artificial, and where you can do as you please; begin when you like, leave off when you like; go where you like, and eat when you feel inclined; carry your own gun, load it yourself,

THE RABBIT IN THE BRUSH PILE.

and be content to use one only; own your own dogs, and work them yourself, and carry your own game, as done in America.

It seems to me that in the one case a man is a sportsman, and in the other, a game shot only.

I have been comparing game shooting as it exists to-day in America with game shooting in England, and trying to show why an American ought to be a better shot than an Englishman, and have given several reasons why it should be so. But so far I have said nothing of the difference between the flight of English and American game, and in this I consider lies one great factor in the case.

There is no game bird in England that is nearly as difficult to kill as the ruffed grouse of America, where that bird has been at all shot at and has learned to distrust the man with a gun. This is especially true where, as in New Jersey and Pennsylvania, these birds are chiefly found on rocky hills covered with timber, and on ground which is constantly overrun by rabbit hunters, for the ruffed grouse and the rabbit love the same ground.

Neither is there, to my mind, any bird in England which is as difficult to kill as the American

quail. These are the birds which teach a man how to shoot, and if he can shoot them well, he need not be afraid of any other kind of game.

English snipe, as they are called in America, are not easy shooting, except in places where they are very tame. They are to be found in much greater numbers here than in England, therefore an American shooter can have much more practice at them.

Duck shooting is much the same in both countries, the flight of the bird being practically the same in England as in America, but of course they are to be found in this country in much greater quantities than in England. The English do not do anything in the way of shooting ducks over decoys, a sport which tests the shooter's skill to the utmost, especially if he is lying down in a sink box or battery, and has to raise himself to a sitting posture before he can shoot.

What may prevent a Man from becoming a Really Good Shot — Selection of Gun — Ammunition, etc.

So much has been written about guns and shooting, especially of late years, that it would almost seem as if there was nothing fresh to be

said on the subject. Yet hardly a day passes when shooting is going on and several shooters are together that one does not hear first one point and then another discussed, with no one, perhaps, appearing to have any very definite idea as to the true answer to the question which has been raised. This is especially the case with regard to the reasons for the misses, which even with the very best shots will occur now and then, and it is a question of such great interest to all shooters, from the very worst to the very best, that I propose to point out the chief reasons why a man misses and how he may cure the weakness.

A moment's thought will show that the fault may either lie with the shooter himself, with his gun, or with his ammunition.

First, as to the shooter's own possible fault. Much depends upon a man's attitude and balance when in the act of shooting. As far as possible the whole body should be flexible and evenly balanced, from the sole of the foot to the crown of the head. Of course a man out after game cannot always choose the moment at which he will be called upon to shoot, and therefore cannot always have his body in the best position. But very often he can, as when standing in a blind waiting for

wild-fowl, or when waiting for game to flush which his dogs have pointed. Nothing will so quickly show the necessity for acquiring the right way of holding the body when in the act of shooting than shooting at some clay pigeons or targets, thrown from a set of traps in such a way that you neither know where the target is coming from nor the direction it is going to take until it springs into view. This is one way target-shooting helps to make a good game shot.

Having got the right position, study to shoot in good time, neither too fast nor too slow. Be ready to snap as quick as lightning at a bird rising wild or in thick cover where only a momentary glimpse can be had of the object, but, on the other hand, never shoot too quickly at an object that is so close to you that your shot has not time to spread. Keep the head well up and both eyes open, so that you can see all that is going on and get in a good and quick second barrel if necessity requires. Keeping the head down low or shutting one eye are both faults of which no really good game shot is ever guilty.

The position of the hands when shooting should also be studied. The grasp of the stock with the right hand should be very firm, the thumb well

over the grip. The right hand guides the gun more than most shooters are aware of, and if not firmly grasping the grip, is not able to do so properly. A loose grip also is the common cause of flinching, that most uncomfortable but prolific cause of misses. Another reason for the very firm grasp with the right hand is that then both hands take a great deal of the recoil off the shoulder, and may prevent a sore shoulder at the end of a hard day's shooting, or a sore middle or index finger. The left hand should not be extended too far, or the shooter will find himself handicapped when aiming at an object coming quickly toward him. On the other hand, if held too far back, he will be less likely to hit an object going away from him or crossing.

Some men depend entirely upon the swing of the gun when shooting at crossing birds, whilst others depend altogether too much upon judging the correct distance to lead them, whereas the very best shots combine both swing and lead.

The heel of the stock must rest squarely against the same part of the shoulder every time, or regular shooting is impossible. When in the act of firing his gun, the shooter has no time to look down the rib to see that his eye is aligned truly down the

centre. If it is not, and he is, as it were, looking across the rib, a miss is sure to follow. If your gun is thrown to your shoulder so that you are pointing straight at a stationary object, or if it is a moving one at the proper point to be intercepted, and yet if your eye is not looking truly down the centre of the rib, but from the right side of it, you will surely shoot too much to the right; if the contrary, too much to the left. In the same way, if the stock is low on the shoulder one time and high up another, in the first instance your shot will strike higher than is intended, and in the second lower.

A good shot will watch, every time he fires, whether he has centred the object he fires at; and if not, will note whether he hit it too far back, too far forward, too high, or too low, and will try to correct his fault next time. A poor shot, so long as he brings his game to bag, thinks nothing of such fine points as this, and so next time, perhaps, is still a little more off his mark, and misses it altogether.

I now come to the faults in the gun itself, which may prevent good shooting.

Any good shot can take any kind of a gun and kill a certain percentage of the game he shoots at

with it, but to be sure of doing himself justice, a good shot requires a gun which suits him; or, in other words, a gun which, when he throws it to his shoulder, at once points where he wants it to, without any apparent aiming on his part. The shooter has enough to do in measuring in his mind's eye the required elevation, lead, and, in case of a high wind, allowance for drift of shot, to be occupied also in looking along the barrels to see if the alignment of the gun is correct.

It therefore follows, that if the gun is not well balanced, if the stock is too crooked or too straight; too much cast off or on, or not enough of either; too long or too short; too thin or too thick where it rests against the cheek; the heel too much sloped; the grip too large or too small; or if the rib on the gun is not the kind that suits him, — and there is more difference in ribs than most shooters have any idea of, — some are flush with the barrels, some are sunk, some are hollow, some are flat, some have a dip in the middle, and others run true with the barrels from breech to muzzle, some are plain, and some checkered; or if the sight is not just right, too large or too small; or in the case of the boring of the gun, making the pattern too close, or the reverse (depending

upon what kind of shooting the gun is required for); or if the gun is badly bored, so that you get a very close pattern one time, and a very open one another, or a stringing pattern, *i.e.* some of the charge reaching the mark before the rest; or (and here is a point few shooters know of) if the striker, or firing-pin, is too short; or if the main-spring is weak, so that, although your gun does not actually miss fire, yet the ignition of the primer is not full and instantaneous, and the result a slow, weak shot or hang-fire, — any one of these causes will be sufficient to affect your shooting to a greater or less degree.

But over and above all these, in my estimation, is the pull-off of your trigger. Some men like a heavy, some a light, and some a medium pull-off. No one can shoot really well with a pull-off that does not suit him, and that does not answer at once to the finger in place of having a drag, which is quite a different thing to its being too heavy. Also remember that the pull-off of all guns will vary from use, some growing lighter and some harder, and it is very necessary, occasionally, to have the pull-off tested to see if it has changed. The pull-off of the second barrel should never be less than four pounds, or it may at any time jar

off when the first barrel is fired, but three pounds is sufficient for the first barrel for most people.

In speaking of a gun being well balanced, it must not be taken for granted that the same balance will suit every shooter, and a man must find out for himself just what suits him best. Much depends on the way in which he holds his gun, especially with regard to the position of the left hand. The weight of the gun and the shape of the fore end also affect the question of balance, and, to my way of thinking, it is one of the hardest points to determine in choosing a gun. In this, as in most other matters, it is best, usually, to hit off the happy medium. A gun that is muzzle heavy will be very likely to make you shoot low on birds, but at the same time it steadies your swing when shooting at game moving fast to right or left, therefore use a gun which is neither too light nor too heavy in the muzzle.

As to the bend of stock, if it is too much bent it will make you shoot too low; if not enough, it will make you shoot too high. Therefore, in choosing the bend of your stock, you must bear these two points in mind, and, as in other cases, hit off the happy medium, remembering, however, that it is better to have a gun too straight rather

than too crooked; for it is far easier when in the act of firing to depress a gun than to raise it, and nine-tenths of the game missed is under, not over, shot.

The question of too much "cast off," as it is usually called, or, as it should be called, "cast on," *i.e.* the heel of the stock being slightly thrown outward from the body, so that the breech of the gun comes nearer in under the eye, has been a very vexed one for many a year. The tendency of shooters, in this country especially, seems to be toward using a gun without any "cast off" or "cast on," but perfectly straight from centre of heel and toe of butt to centre of rib at muzzle; and I believe it is the best plan, and for a long time past have had all my guns built in that way, and have shot better in consequence.

If the stock is too long, it will hamper you in throwing the gun to your shoulder quickly and unexpectedly, a thing which in game shooting must frequently occur, and a long stock is unsuitable for snap shooting, shooting in a cramped position, or at an object coming toward you. If it is too short, it will not come into the same spot in your shoulder each time as it should do. If too thin, and I think stocks are usually made too thin,

on the side next the cheek, you are handicapped by not having that proper rest for your cheek which is a great assistance in shooting. If the heel of the stock is too much sloped, the gun is likely sometimes to slip down from the shoulder after firing the first barrel and prevent your putting in a good second.

As to the grip of the stock, some men shoot much better with a larger and some with a smaller one. The smaller one gives the handsomest look to the stock, but is more liable to get broken. I have seen the stock of a gun, more than once in my experience, break off at the grip only from the recoil of the gun when fired. A small grip, however, suits most people, especially in a light gun and when intended for game shooting or anywhere that quick snap-shots are expected.

Just what sort of rib suits a man best is very hard to say. I have seldom met a man who expressed any great preference for one pattern or another; but I know that as regards my own shooting the rib will have more to do with it than almost anything else, and I believe this to be the case very often, only it is not a point that has been taken up much by handlers of guns, and when they find they cannot shoot well with this

or that gun, they attribute the fault to almost anything except the rib. No good shot, so far as he knows, either closes one eye or looks along the rib, and theoretically as regards his shooting this or that rib should make no kind of difference. I say theoretically, but practically it does, as I have proved to myself and others beyond any doubt.

Some ribs when you look along them, aiming in cold blood at a stationary object, appear to keep your eye *nolens volens* along the very centre between the two barrels, whilst others appear to do the very reverse.

Now as to the pattern your gun makes. Nothing is more absurd than to go into the field for all-round field-shooting with a gun which is full choked in both barrels. The best shot in the world could not make good shooting with such a gun at any game which, as in the case of quail and woodcock especially, has usually to be shot at distances varying from fifteen to thirty yards; yet many men try to do it. Even if the gun is not full choked, yet with one so bored that it makes a close pattern at forty yards, if the game is killed it is terribly mangled, and some of it not fit for use.

A game gun for all ordinary shooting and with

an ordinary game load should at thirty yards scatter the shot equally all over a thirty-inch circle, leaving no space where a bird as large as a quail could have escaped. But that same gun is not a close enough shooter for wild-fowl or ruffed grouse when these are at all wild.

In testing a gun to see what pattern it makes, do not be satisfied with firing a few shots with one sized shot only. It frequently happens that a gun will pattern well with, say, No. 7 shot, and will make a most indifferent one with a size larger or smaller. A well-bored gun should pattern well and evenly with all sizes of shot.

It is also common to find a gun which will perhaps make several very nice, evenly distributed patterns in succession, and the next time give such an open or patchy one that no matter how straight it was pointed the object shot at would very likely escape through the gaps left between the pellets.

As far as I know, no exhaustive and scientific experiments have ever been carried out with a view of showing why one gun or one load will string the charge of shot so much more than another.

Mr. Griffith, in England, carried out experi-

ments to elucidate this point some years ago, on a circular revolving plate, but I believe his apparatus broke down before he had gone very far in his trials, and I have never heard of their being repeated by any one else. These experiments showed that there was stringing to a much greater extent than was generally supposed, but failed to prove the cause or discover a remedy.

That some guns do throw the charge of shot, or a very large percentage of it, so that at forty yards the greater number of pellets reach the object fired at simultaneously, whilst others send a few pellets in advance and the rest come in a more or less lengthy string behind, cannot be doubted; also that certain shells will act in the same way, even when fired from a gun which, with different ammunition, reduced this stringing to a minimum.

You may test your gun for pattern at a fixed metal target, and the result is most satisfactory: the pellets are evenly distributed, and on counting them you find the percentage of those in the thirty-inch circle all that you can wish; but on close examination you will see that a good many of these pellets have not struck nearly as hard as the others, this being shown by the larger splash

made by some; and if you carry your examination still farther, you will find evidence that only a moderate percentage struck the target first, and that the remainder came up in an extended string. This means that the first pellets had the most velocity (and therefore penetration), whilst the rest had less velocity and less penetration, and yet these had all made their mark on the target and produced the pattern which until you analyzed it looked so satisfactory. But it also means that if you were firing at a very rapidly moving object, that object would only have been struck by the few pellets that came first, which might have been altogether insufficient to kill it outright.

The moral of this is, beware of a gun or load which strings the charge of shot.

Another bad feature in a gun or a load, which is very often present, is the shot balling, *i.e.* several shot, perhaps three or four, or perhaps thirty or forty in bad cases, are driven together into one solid mass whilst the charge is passing up the barrel.

Not only does such a mass of shot travel faster than the individual pellets composing the charge, but it is probable that these masses are formed by

the shot in the rear, and therefore as the whole charge emerges from the muzzle these balled shot pass through, knocking other pellets right and left, and producing a patchy pattern and perhaps causing you to miss what you have shot at.

These balled shot travel very long distances and have been the cause of many so-called unaccountable accidents. A shooter should always bear in mind that balling is not of uncommon occurrence, and never fire in the direction of human beings, buildings, etc., although such may be well beyond the range of ordinary shot.

A case occurred at the Gun Club, London, some years ago, which exemplified this very forcibly. The ground is surrounded by an eight-foot fence or wall made of slabs of concrete, with no openings in front of the traps. The wall is eighty yards from the traps. The adjoining field is used as a cricket ground, and a lad standing in that field at least thirty yards from the wall had one of his eyes shot out by what must have been a balled shot fired in the club grounds. The boy could not have been less than one hundred and thirty yards from the shooter, and perhaps a good deal more.

Experiments have shown that this balling may

be caused either by the shoulder of the shell chamber being too abrupt, or by very hard wadding, or lastly by powder which ignited too rapidly and caused the charge of shot to move up the barrel too rapidly.

Any one of these may cause balling, and they may all exist at the same time, in which case the balling would become excessive.

Mr. W. W. Greener, the well-known English gun-maker, in his book on "Modern Shotguns," at page 79, says, "Occasional bad patterns or patchy patterns prove the gun to be improperly bored." Mr. Greener being himself a practical gun-maker, should know better than most people whether this is the case or not. Yet I cannot agree with him altogether in this statement, for I have often seen a gun make such patterns from faulty ammunition alone, where the blame could not be laid on the gun.

Ammunition

I will now pass on to the defects which may be and often are found in ammunition, and which when they exist may be as fatal to good and regular shooting as any fault in the shooter himself or in his gun.

The length of the shell used should always fit the chamber of the gun; a two and three-quarters inch shell used in a gun only bored for a two and five-eighths shell, the usual length for game shooting, may give very irregular shooting, and more so if a still longer shell is used. This is not, however, always found to be the case, and I have come across some guns which would pattern better with a longer case than the chamber was bored to receive.

If too much pressure has been put upon the powder during loading, a greater degree of lateral pressure will be set up; there will be a louder report, more recoil, less penetration, and irregular patterns. The proper amount of pressure varies with different makes of powder; but as a general rule the powder should be slightly compressed, so that if the wadding is removed and the shell held upside down, no powder will run out till it has been gently disturbed with a penknife or something of that sort; at the same time it should not be necessary to dig the powder out, and none of the grains should be broken. If, on the other hand, the powder is not compressed at all, but is loose in the shell, slow and imperfect ignition will follow, with great loss of penetration. With nitro

powders, as all the powders of the present day are called, since black powder went out, killed by its own noise and smoke, much depends on the wadding used. The amount of wadding is not of so much consequence as that it should fit very tightly into the shell first and the barrel of the gun afterward. One of the best shots in the world, as well as one of the most practical shooters I ever met, has all his ammunition loaded with at least one ten-bore wad, though his guns are all twelve-bore. It is, however, extremely difficult to press down a wadding which is so many sizes larger than the shell without a risk of having it tilt at one side or the other, which is sure to give ragged patterns, or of bulging the case, which makes it difficult to get the shell into the gun or extract it after firing.

I never use a larger wad than eleven, and consider eleven and a half quite large enough for all practical purposes.

Some people like a thick, hard wad, like the "Express"; but I have seen so many guns bulged at the muzzle by the use of such wadding, that I would never use it; and there is also a danger of the heavy, hard wad deflecting much of the charge of shot, producing bad pattern. All hard wadding is likely to produce poor pattern, and

that means poor shooting in the long run. If the wadding is insufficient in quantity, or too small, it allows the gas, as it begins to form from the ignition, to escape past it and penetrate the shot charge, sending it in every direction but the right one. If the first wad over the powder is ever allowed to go down edgeways, a weak shot will be the result.

The crimp of the shell materially affects the shooting of a gun. If there is not enough crimp to hold the top wad firmly over the shot, there will be loss of velocity and penetration. If there is an undue amount of crimp, there will be uneven patterns.

Some people fancy a round crimp, and some a square, but experiments show that one is the same as the other as regards actual results.

If either the fulminate in the primer or the powder in the charge has been affected by moisture, the result will be a weak discharge and loss of velocity; but a charge of powder is still more affected and rendered useless if shells are kept even for a short time in such a hot place that the grease which is in the paper of the shell is melted sufficiently to be absorbed in ever so slight a degree by the powder; standing in a hot

sun will soon do this. If there is any fault in the primer of the shell, it is fatal to regular shooting.

All nitro powders require a strong, hot flash from the primer to ignite them thoroughly and produce proper combustion. A weak primer means slow combustion of powder and consequent weak action in propelling the shot. On the other hand, too much fulminate or too strong a primer means too rapid ignition of the powder, and causes loss of velocity and poor pattern.

If the class of cheap shells now on the market is carefully examined, it will be found that in some cases the flash hole of the primer is partially or wholly stopped up by part of the paper forming the base of the shell. In every such case a misfire or imperfect combustion is sure to follow. The same must happen even with the best shells if any foreign substance has fallen into the flash hole.

Very few shooters have any idea how much the quality of the shot they are using may affect their shooting. It is easy to understand that shot that is irregular in size or shape would give irregular and poor patterns; but not only is that the case, but the harder the shot is, the closer will be your pattern, as well as the more regular. Even with

chilled shot, some is much harder than others, and it is invariably the case that the hardest chilled shot will give closer and more even patterns than another make which is not quite so hard; and the difference is greater than any one who has not tried it would imagine possible. When you come down to soft shot, the difference is even more apparent, and you may have your gun loaded with most perfectly regular shot as to size and shape, which will yet give such poor patterns that you may easily find yourself missing shots without any apparent reason. The explanation of this is, that the shot is flattened in passing up the barrel, in proportion to its softness.

Much has been written on shooting, but this is a fast age, and what was true of guns, ammunition, and shooting yesterday, requires modifying and adding to to-day if we intend to keep up with the times we live in.

There are, I believe, very few shooters who would not wish, no matter how perfect they are already, to be able to do still better; and amongst all the good shots I have met, I have never yet come across the man who was not trying to find out some way of avoiding that inevitable miss that will put in its unwelcome appearance now and then.

It is probable that few, if any men living, have burned up more ammunition, shot a greater variety of game, and handled more guns than I have, in the field and at the traps, or in experimenting at a stationary target, with all kinds of ammunition, and in these articles I am endeavoring to give to others, in as practical a form as possible, the result of my experience.

At the present time, in this country, there is a great demand for lighter guns and smaller bores, and many are becoming advocates of guns with only one trigger.

As to lighter guns and smaller bores, I, like many others, caught the infection some twenty years ago, when there was a strong move in England in that direction. I had twenty-bores and sixteen-bores, but gradually I, like every one else I knew, came to the conclusion that for all-round shooting, and to get the most that could be got out of a gun, there was nothing to beat the medium weight, No. 12 bore.

The same may be said about length of barrel, — twenty-six, twenty-eight, thirty, and thirty-two. Each has had its advocates, but thirty inches stands as the standard and most useful all-round length.

As to the single trigger action on a gun, which is being pushed very hard at the present time, theoretically it ought to be a vast improvement on the old-time action, and at one time I was persuaded that it was only necessary for a man to get used to handling one of these guns to beat anything he had ever done before. I remained unconvinced that I was wrong for nearly two years, despite repeated failures, and spent much money on this new fad; but, like every good shot I know who has tried them, I went back to the old two triggers, and I am fully assured that even if the action were quite perfect, and as little liable to fail as the two triggers, that there is no real benefit to be gained, but rather the reverse.

An undoubted weakness in American-made guns, which are otherwise so good, is the rough finish and poor quality of the locks, as compared with English-made guns of a good grade, and I hope to see the time come soon when this will be remedied. Not only is it of great consequence to a shooter that his lock should not get out of order, or the pull-off vary, but the quicker the action, *i.e.* the less interval there is between the pressure of the finger on the trigger and the blow of the striker on the primer, the more likely you are

to hit the object aimed at. The advent of the chronograph has taught us many things that we only surmised before, and one of these is, that this interval is an appreciable quantity and should be lessened as much as possible. To show how much this may be the case, I will here mention, what is a clearly demonstrable fact, that to hit an object which is crossing you at right angles forty yards away, and moving at only the very slow rate (for a bird's flight) of forty miles an hour, you must make the centre of your shot strike eight feet ahead of that object, or, owing to the interval after pulling the trigger, and allowing for the time it takes for the charge of shot to reach forty yards, the bird, or whatever you shot at, will have passed on, and your charge will strike behind it. Some makes of guns are appreciably quicker in the lock action than others, and hammerless guns are usually quicker than those made with hammers.

Such lamentable accidents are continually happening with guns from careless handling or from the want of a true knowledge of where the danger comes from, that a few words on this subject cannot be out of place. The breech-loading gun is unquestionably safer than the muzzle-loader, and the hammerless safer than the gun with hammers.

It is true that with a hammer gun you can always see that it is cocked, when the hammer is raised; but the same hammers are an endless cause of accident from catching in a bush, etc., or from escaping from under the shooter's thumb when in the act of cocking or uncocking; this is especially the case on a cold day, when the hands are stiff with cold.

The most fruitful source of accidents with guns arises from shooters having too much confidence in their guns never doing anything they should not. Thus, a man has closed his gun hundreds of times and never known it to go off in the act of closing, and yet it is quite possible that this may happen at any time. Always, therefore, be specially careful in closing your gun that the muzzle is not pointing toward any person. Also be careful when closing a loaded gun to have a sufficiently strong hold of it, so that if one barrel does go off, the gun will not fly out of your hand from the recoil. I saw this nearly end in a fatal accident once, when one barrel of the gun of an old sportsman and well-known game shot standing near me went off as he closed it after loading. The gun flew out of his hand, and the butt being the heaviest end struck the ground

first, jarred off the other barrel, and sent the whole charge through the brim of the shooter's hat so close to his forehead that the skin was cut by the shot.

Remember always that a loaded gun, no matter how good the action is, may go off at any moment either from being jarred off or even without a jar, if, as is always possible, a piece of grit, or metal, or any foreign substance has got into the lock action.

A loaded gun, whether with the safety bolt on or not (for even safety bolts are liable to fail), should always be regarded as a danger, and in getting over a fence or any difficult spot, or when resting the gun against a tree, etc., or putting it down in a boat, the only really safe plan is to remove the cartridges for the time being.

To show how much caution is required, and how common accidents with guns in the field are, I may mention that I have myself been shot three times, twice owing to gross carelessness on the part of my companions. Besides these times I have seen more men shot than I care to think about, and in one case fatally.

Make it a rule never to shoot at game on the ground or flying low, unless you are positively

certain that there is no one in the line of fire. Don't take any chances, or, for the sake of killing one more quail, run the risk of killing or maiming a friend, it may be, or at any rate a fellow-creature.

Whilst on the subject of danger let me say a word about guns bursting.

Some people have an erroneous idea that since the advent of smokeless powders there have been more guns burst than used to be the case with black powder; or, in other words, that smokeless powders are in themselves more dangerous than the old-time black. This most certainly is not the case.

All good gunpowder of every description is very strong in its action or it would be of no use, and it must be used with discretion. Smokeless powders exert their greatest lateral or bursting pressure nearer the breech than is the case with black powder, and therefore this part of the gun should be always strong, and a gun which has not a good thickness of metal at and just in front of the cartridge chamber should be avoided. The tendency of manufacturers of smokeless powders of late has been to make the powders stronger, so that a smaller charge should do the same work that a larger charge of another make

would do. Such powder is called condensed or "dense powder," as against the other kinds, which are termed "bulk" powders. In using a condensed powder it is necessary to take even more precaution than with a bulk powder, to be sure that an extra quantity of it has not inadvertently been placed in the shell when loading, otherwise the action of such powders is just as safe as is the case with the bulk powders.

Up to the present I have been treating of all-round game shooting, and guns and ammunition for the same.

There are people who think that one kind of gun should be sufficient for all and every kind of shooting, and Mr. Teasdale-Buckell, in his work on guns and shooting, published 1900, at page 103, gives that as his opinion. This is perfectly true if a man is willing to be content with something less than the top notch; but if he has the wish, as well as the ability, and also the spare cash at his disposal, to make himself as good or better than his neighbor at every kind of shooting, he must not rest content with only one gun, no matter how well that suits him, any more than with using only one sized shot or one fixed load.

One bend of gun, when you have found the

bend that suits you best, may perhaps do for most kinds of game shooting; but I have never seen the man yet who was a really good trap shot who did not use a straighter gun for that than he would choose to use on game, especially if the game was coming toward him, such as driven grouse or partridges in England, or flight-shooting at wild-fowl in America.

A very few years ago the majority of shooters in America were using very heavy and very much bent guns. To-day all that is changed. The schoolmaster, in the shape of trap-shooting at targets especially, has been abroad, and the gun in general use now is neither heavy nor bent. How this has come about will be explained later on, when we are speaking of this form of shooting and its effect on game shooting. A very heavy gun is an abomination for any kind of shooting, unless the object in having such a gun is to get the heaviest kind of load into it, with a view to shooting into flocks of birds and killing the greatest possible number, which is only done by market hunters and the like. A lighter gun can be handled and brought to bear on single birds so much quicker, that many more will be brought to bag in the long run with the lighter than with

the heavier gun. On the other hand, for really good shooting a gun may easily be too light, and whilst everybody would prefer, through a long day's tramp, to carry a gun weighing six pounds or less, yet the average shot will find that he will miss fewer times, other things being equal, with a gun weighing six and one-half to seven pounds.

This also is a lesson which I believe trap-shooting has taught more than anything else. The lighter gun will shoot just as well and kill as far, but the extra weight is required to steady the swing, and it is easier to point, time after time, where you wish with the heavier, so long as you do not overdo it, than with the lighter guns. The same remarks apply to the length of barrel. Twenty-six and twenty-eight inch barrels are delicious to handle, but are not so easy to control as thirty inch, when swinging on or ahead of a quickly moving object.

The moral to be deduced from the foregoing is this: if you are a believer in the theory that one gun should suffice for all your wants, and those wants are supposed to cover all kinds of game shooting, from the soft little woodcock that swishes up so quietly from under your very feet, to that grandest of birds, a wild turkey, then you

should supply yourself with a twelve-bore hammerless gun of medium weight, right barrel cylinder, left full choke, an ejector with stock of medium bend, and be especially careful that you have one that will throw large or small sized shot equally well. But if you want to be on equal terms with others who have various guns for various kinds of shooting, then have the following: —

1st. A light twelve-bore hammerless ejector, with twenty-six or twenty-eight inch barrels, not weighing over six and one-half pounds, which will give a regular but open pattern with both barrels at thirty-five yards with small-sized shot. The stock should be rather more bent than you would have with guns which you intend to use on larger game, because you are going to use this gun chiefly on such game as quail and woodcock—birds that love cover, and where you want to keep your head up in shooting and snap at all sorts of shots, with perhaps occasionally only a momentary glimpse of what you are shooting at. Do not get a sixteen or twenty bore, because the grasp of these in your left hand is quite different to that of twelve-bores, and may spoil your shooting when you next use a twelve. The chambers should be

bored only for a two and five-eighths inch shell, as you should never use anything but a light load with such a gun.

2d. For all kinds of wild-fowl a man should have a gun which will carry a heavy load of both powder and shot. These birds are so protected by their thick plumage that if you do not wish to run the risk of maiming many a one that you shoot at but do not kill, you will use larger sized shot, according to the size of the game you are after, with a heavy charge of powder behind to drive it home. As most of this shooting is done in the open, where you have a full view of the object you are shooting at, your gun should be straighter than the ones you use in cover, the barrels should be thirty inch, and the gun weighing about eight pounds, with chambers bored for three-inch shells. Both barrels should be full choked.

If you intend to shoot at the traps, either at live pigeons or clay targets, you will hardly be content to use any one of these guns. Under the best rules governing trap-shooting you are not allowed to use a gun weighing more than eight pounds or of larger caliber than No. 12 gauge. This rule was made because it was found that in

this form of shooting, at all events, a very heavy gun was an advantage according to a man's strength and power to handle it, so that if there was no limit made, a powerfully built man could, by using an extra heavy gun, have an advantage over a man of slighter physique.

The reasons for this being so are plain. A man at the trap stands in readiness for it to be pulled when he gives the word, and may hold his gun up to his shoulder, or in any position he chooses, before calling "Pull." He knows pretty well where the object he is going to shoot at will start from, and just how far away from him it is at the moment it starts. If he is shooting at live pigeons, he must not only kill the bird he shoots at, but he must kill it so dead that it is unable to cross the boundary line, which is sometimes a fence, but more often a low wire boundary less than three feet high. This boundary is seldom, if ever, more than fifty yards, and often only thirty, and sometimes twenty-one, the boundary being measured from the centre trap. If the pigeon is not killed or so severely wounded that it cannot cross that boundary, if it falls just outside, or even perches on the boundary, it is just as much a lost bird as if it had flown away absolutely untouched.

He therefore requires a fast, smashing load, and nearly all pigeon shooters use heavy loads in both barrels. But if this heavy load is put into a light gun, it will "jump" from the recoil when the first barrel is fired, jumping sufficiently to disconcert the shooter, and prevent his getting in his second barrel either as fast or as true as he would like. Also the heavy gun, provided it is not too heavy for your strength, will swing with a more even motion, and enable a man to hold truer on the object.

The same remarks apply to shooting at clay targets, with the one exception that, as you are going to shoot at a good many targets in rapid succession, you would never dream of using as heavy a load as for live birds, because your shoulder would never stand it. Still, you do want a good, strong load, and if you were to put that same load into a light gun, you would soon have to stop shooting, or find yourself flinching, and misses coming faster than they should.

There being so many known quantities in both live bird and target-shooting from traps, a man is at liberty to choose a gun which specially suits him for just that one particular kind of shooting. For instance, the ground, wherever traps are used, is

generally level and free from trees; you are, therefore, looking each time for a rising object to shoot at, whereas in game shooting you may be firing at a bird going up or down hill. Again, the conditions between live bird trap-shooting and target-shooting from traps are sufficiently different to make a person, who wishes to excel at both, choose a somewhat different make of gun for each. These differences will be mentioned later on.

I have not, so far, said much as to the various bores of guns, and many men are great advocates of smaller bores than No. 12. I have seen wonderful work done in the field with both sixteens and twenties, and I have shot them both a good deal myself; but the average shooter will always do better work, in the long run, with a twelve-bore, and for that reason it has been the standard bore for many a long year, and will, I think, continue to be so for all time. For women or children, the small bore with its small grip is suitable, and also you can get better shooting out of a small bore, when it is an object to use a very light load, than the same load will give out of a twelve-bore.

How Trap-shooting helps to make a Good Shot

A great deal has been said and written on the subject of trap-shooting as regards its effect on the game shot, some believing that trap-shooting will not only not teach a man or boy how to become a good game shot, but that it will make him a bad shot in the field if he is a beginner, or injuriously affect his shooting if he is already a good game shot.

Speaking from my own experience, as well as that of others, I think that trap-shooting by itself, whether at live birds or targets, would never make a first-class game shot, but there is no way in which a beginner can so quickly learn to handle his gun with ease and safety to himself and his companions as at the traps. There is, also, no other way in which he can learn as much about the technical points, which all good shots should learn, so as to find out whether the gun he is using suits him or not in shape and balance; whether it is a regular shooting gun or the reverse, or whether the ammunition he is using is the best, etc. There undoubtedly is no school for a shooter like the traps, especially if he mixes freely with others,

attends shoots where the best shots are to be found, and gathers knowledge from them. When he goes into the field he will have to unlearn nothing, but he will there find a great deal more which must be learned before he can become a really good shot at game.

I have heard a great many men say that trap-shooting spoils them for shooting in the brush for a time, but I never remember an instance where the speaker was at all a good trap shot, and I have never known a really good trap shot who was not also a good game shot.

It is no exaggeration to say that in the last ten or fifteen years clay-bird shooting has revolutionized both the manufacture of guns and also of ammunition. Before that time it was quite usual to find a man using a heavy, badly balanced gun, whilst ten-bores were common. Now it is a very rare exception to find a man using anything but a gun of the most modern type; and ten-bores, except occasionally for wild-fowl shooting, are extinct.

The same might be said of ammunition. Each man used to think he could load his own ammunition and get the best results. Now it is a rare thing at tournaments to see any except factory-loaded ammunition, for the reason that the shell-

loading companies have kept up with the times, and can and do load their shells with all the various kinds of powder and shot in a way to get the best possible results from this or that load, and this or that make of powder.

Target-Shooting

It is the trap shooters of America who have obliged the shell-loading companies to give them perfect ammunition, quite as much as or more than the keen competition which exists between those companies, the reason being that where so many shooters are collected together in competition as is the case at clay-target shooting, and where five men at a time are standing in a row, shooting rapidly one after the other, nothing is easier than to detect a cartridge which is slow in ignition or weak in action, and such ammunition would be at once condemned.

Target-shooting is not easy; it is difficult, and to excel at it a man must not only be a good shot and have a gun which suits him perfectly, but must also have ammunition which will give him a perfectly regular pattern every time, and reach the object with the least possible delay.

When target-shooting was first introduced, the

targets were sometimes made much more brittle than is now the case, consequently if it was attempted to throw them any great distance, they would too often break up. Now, with improved traps and improved targets, they are thrown much faster and travel much farther than used to be the case, and are correspondingly harder to hit, and must be hit with several pellets to make them break. No one in his senses would ever compare trap-shooting in any form to shooting wild game in the fields, mountains, or woods, and it must be understood that in writing about trap-shooting I only speak of it as a valuable assistant to one who wishes to excel in field-shooting, or as a pleasant way of spending a few hours at any time when all kinds of game shooting are barred. It is true that some men get very enthusiastic over it, but that is more on account of the way it brings shooters together from all parts, and the consequent emulation to be, if not the best, as near as one can get to it.

It is wonderful how clay-target shooting has grown and flourished since it was first introduced, not so very many years ago. The number of clay targets sold annually in America is beyond all belief, and year by year the quantity increases in

place of diminishing. In an article, therefore, which is devoted to shooting, this branch of the sport deserves more than a mere passing notice.

In 1901 a match was arranged between a team of American trap shots and an English team, to be shot in England, the Englishmen to have use of both barrels at each target, the Americans to use one only. I was asked to act as referee for both the Americans and Englishmen, and therefore had an opportunity of watching and hearing everything that passed. On our first arrival, the common talk was that, as the Americans generally practised target-shooting so much more than the English, it was quite likely that the English team would not have much chance if they shot on level terms; but the arrangement made, that the Americans should use only one barrel to their opponents' two, would, it was thought, equalize matters.

Before the match came off a live bird shoot from traps was arranged, open to any who chose to compete. This was a different kind of game, and there was much talk and conjecture as to how a number of Americans just landed in the country, none of whom had ever before shot at English blue-rock pigeons, would hold their own with some of the best shots that England could pro-

duce, especially as the Americans, from the mere fact that they were accomplished target shots, were presumed not to be so good at live pigeons. After that and some subsequent live-bird contests, however, there was no talk of Americans being inferior to Englishmen as pigeon shots. Then came the clay bird contests, and before they were over it was universally admitted that not only could the Americans beat the English at any kind of shooting, but that they were better equipped as to guns and ammunition than their antagonists, and that this had very much to do with the superiority shown by them.

Here, I think, is a great point of difference between an English and American shooter. The one is content very much to take what other people tell him as gospel and stick to it, and the gun-makers in England tell the shooters what suits them, the gun-makers, best; whereas the American judges for himself. Whatever he starts out to do, he is never satisfied to do in a half-hearted way; he never rests until he has acquired the highest possible results, and he generally succeeds. He long ago realized that he could not break target after target with the necessary degree of accuracy to put him in the first flight if

he used the same gun or ammunition that he used for game; and so he changed. The members of the English team were using light guns, light loads, and the same make of gun that suited them for field-shooting; and I should be very much surprised to find that many, if any, of that English team have made any change since.

The advent of smokeless powders has no doubt helped to bring clay-target shooting to its present high state of popularity. Few men would care to shoot in a squad long if they as well as their neighbors were using black powder; but with the absence of smoke to blow back into the eyes, the less noise and less recoil given by smokeless powders as now made, there is nothing to detract from a man's enjoyment. It is the only kind of shooting in the world where a number of men stand shooting in line in rapid succession, and having the result of each shot scored for or against them, where squad after squad follow each other without a moment's delay; and a man who is fond of firing a good many shots in an afternoon will find no difficulty in getting through about as much ammunition as he can comfortably carry.

How to become Expert at Target-shooting

To be a real adept at target-shooting a man requires keen eyesight in a greater degree than for any other kind, as not only is the object shot at small, but the one point of all others that a target shot must study is to catch sight of the small, saucer-like object the moment it emerges from behind the screen covering the traps and the boys working them.

Don't try to see it one foot or one yard beyond the screen, but at the very edge of it. This will mean that you will be well on your target and ready to fire at it ten yards nearer than if you sighted it an infinitesimal part of a second later. This ten yards means a great deal on an object as small and moving as fast as a clay target, because ten yards farther you may have openings in your shot which will allow it to escape altogether unhit, or too few pellets may have struck to break it.

In target-shooting it is not so necessary to have a smashing load as in live pigeon shooting, because the target after being struck at once falls to pieces, provided it has been hit by enough pellets.

The usual load adopted by the best shots is 3 drams or $3\frac{1}{4}$ drams of any bulk nitro powder, or

its equivalent in a dense powder, with $1\frac{1}{4}$ oz. No. $7\frac{1}{2}$ chilled shot.

Constant practice is an absolute necessity if a man aspires to be a good target shot, and even when he has acquired a great degree of proficiency he will quickly find himself out of form if he neglects to practice.

When I first began shooting targets, I asked a professional who then, as he does to-day, stood in the very front rank as a target shot, how he accounted for being so good as he was. His answer taught me a great deal. It was, " Constant practice, using my head, and never firing a shot that I did not put all my mind into." This last sentence is worth taking to heart and thoroughly assimilating.

In shooting of all sorts, but especially at targets, three things must work in perfect harmony and at the same instant of time, viz., hand, eye, and brain; and if the latter is thinking of something else, or not keenly fixed on what the hand and eye are doing, you may succeed in hitting what you shoot at, but you are very likely to miss.

Though personally I do not agree with them, yet so many people are of opinion that live bird shooting from traps is cruel, and like neither to

take part in it themselves nor see others doing so, it may well be claimed for target-shooting that there is no shadow of cruelty about it. Then there is no betting carried on in target-shooting as is so often the case in live-bird shooting from traps. Also, it is much less expensive, and lastly, targets fly equally well in wet or dry weather or on any kind of ground, whilst live birds will not fly well and are therefore useless to shoot at in wet weather, and will not fly at all fast and afford no sport on some grounds, for reasons which seem apparent to the birds themselves, but can only be guessed by a human being.

Since this form of shooting was first introduced it has undergone many changes.

As first practised it soon became too easy for the crack shots, and changes not only in the targets themselves, as well as in the traps they were thrown from, but also in the method of shooting at them, were introduced with a view to making the game more difficult.

The usual plan adopted now at clubs is to have three traps placed four feet apart behind a screen which entirely hides them, as well as the men or boys working them, from the shooter.

The shooters, in squads of five or six, stand in

the segment of a circle sixteen yards in rear of the traps, with an interval between each shooter of four or five yards. The shooter is allowed the use of one barrel only, and the moment he has fired the referee calls "dead" or "lost," as the case may be; the next man then fires, and so on down the line till the last man has shot, when No. 1 again shoots, followed by the others, the shooters changing their position from left to right after each shot, or in case of the event being at fifteen targets, after every third shot; if at twenty targets, after every fourth shot, etc., so that each man shoots the same number of times from each position.

The quickness and regularity with which shot follows shot is very noticeable in a squad that is made up of men used to the game, and it is very disconcerting to such men to have in their squad one who needlessly loses time, who will talk to his neighbor, or who does anything which breaks the even regularity of shot following shot.

Any one, therefore, who shoots targets, should study to be quiet, quick, and regular. He will find not only that it improves his own shooting, but he thus avoids making a nuisance of himself to others.

The shooter is not supposed to know which of the three traps is going to be pulled when he gives the word "Pull," and the trappers should change the direction in which the trap just pulled was set, after each shot, so that no one of those shooting can tell either just where any target is starting from or the direction it will take.

The traps are so arranged as to throw the targets not less than forty nor more than sixty yards, and should be so adjusted that the flight of the target will at ten yards from the trap be not less than six feet in height from the ground nor more than twelve feet.

Target-shooting is a game, not a sport. It is a healthy, open air game in which any one, old or young, man or woman, can indulge without any very great expense or much preparation, — a game which, started as it was only in the eighties, has already become national in America, and grows in popularity from year to year. It is hard to overrate its usefulness as a means of teaching how to shoot.

A new form of trap has lately been introduced, which is held in a person's hands, and the spring working the trap released by pulling a trigger. It will throw the same form of clay target as the other traps, and throw it as far, and at the will

of the person handling it can be made to throw in any direction without having to alter the mechanism in any way.

I was told the other day that targets could be thrown with this trap in such a puzzling manner that, whilst the shooter had a perfectly fair shot at the target, so far as seeing it and distance from him went, he would yet, no matter how good a shot he was, not be able to break much, if at all, over one-half of the targets so thrown. I was so unbelieving that I went to see for myself, and found that I had not been misinformed.

The targets were thrown diagonally across the shooter, some high up, some low down, some edgewise, others flat, and owing to their speed and irregular flight not half of them were broken. This trap weighs only eight pounds, and can be put in your valise when going into the country.

In trap-shooting many ways have been tried of bringing the crack shots down to the level of their less accomplished brethren by some form or another of handicapping.

The only satisfactory way of doing this is by distance, *i.e.* putting the poorer shot nearer the traps, and the expert man farther back, — sixteen yards is considered the ordinary standard distance,

— and it used to be thought that the pattern of guns would open up too much if a man stood much, if any, farther back; but experience shows that the best shots can still break nearly ninety per cent at such distances as twenty and even twenty-two yards — a wonderful exemplification of what the guns and ammunition of the present day are capable of doing.

Trap-shooting can be made of great benefit to both game and pigeon shots by showing a man his weakest point, and enabling him, by practice at targets thrown repeatedly in that direction, to overcome it.

Most men shoot a bird crossing from right to left better than one flying from left to right, but sometimes it is just the other way.

After shooting for a time at targets thrown rapidly, first at one angle and then at another, yet never knowing beforehand which is coming, you will soon discover where your chief weakness lies, and by having that bird thrown to you again and again, will easily remedy your fault.

Live Pigeon Shooting

Live pigeon shooting from traps is, from a humanitarian point of view, cruel. So is all

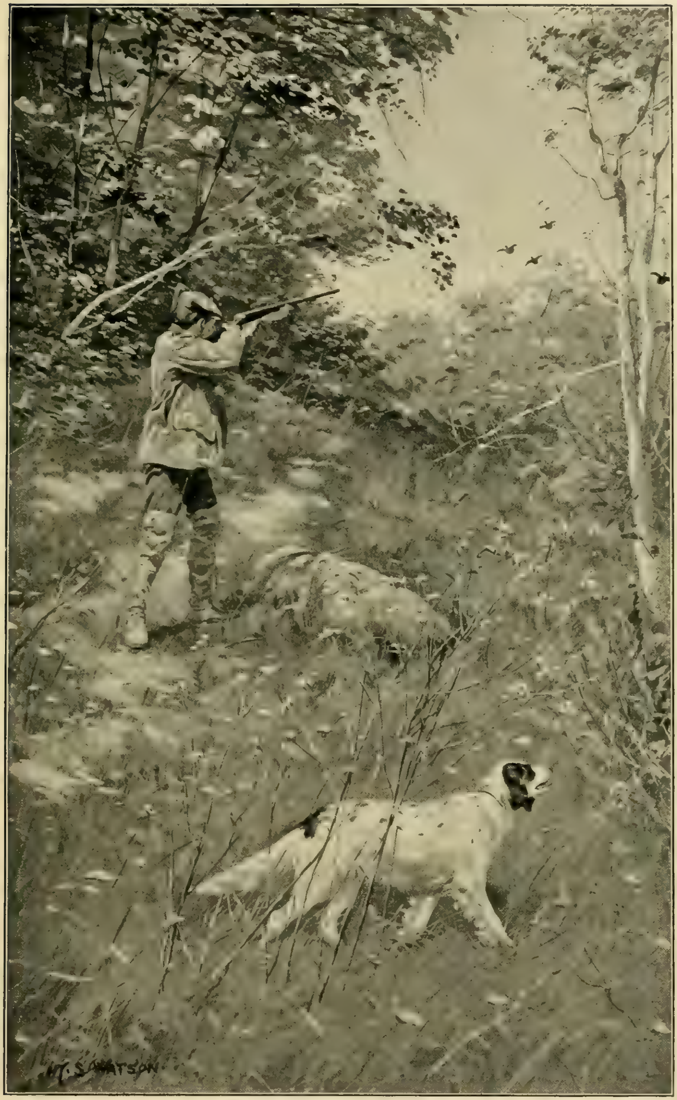
shooting at live animals, and no one has felt this all his life more than the writer. Yet, carry this sentiment a little farther, and you become of necessity a vegetarian, for it is cruel to put an animal to death in order that you may feed upon it afterward. Some years ago, in England, I was in the same house with a man whose whole idea was to save animals from suffering. At dinner, one evening, he told me of a great case that the Society for the Prevention of Cruelty to Animals had against a builder at Brixton, a suburb of London.

His story was that this builder owned a brick field at the foot of a steep hill, and was building miles of houses on the top of the hill, so that all the bricks had to be carted up the hill. This was done in the usual two-wheel, one-horse cart, common for that sort of work in England; but when the hill had to be ascended, the cruel drivers had been in the habit of getting on to the horses, so that not only had they a heavy load to drag up a steep hill, but had, in addition, to carry up the brutal drivers, who were too lazy to walk. He added that the case was up for trial that day, and he was very anxious to see the evening paper, and find out how much the cruel builder in question had been fined.

My friend was a heavy man, and I myself weigh less than one hundred and thirty pounds; but I astonished him by saying that, if he would let me take another fairly heavy man, who was one of our party, on my back, I could pull the speaker out of the room, whereas, without the weight on my back, I certainly could not move him, and that I thought he would find that, in place of the drivers being brutal and unfeeling, they had been doing the very best thing they could for their horses. This turned out to be the defence at the trial, and a verdict was given for the defendant.

No one blames the society or their friends for striving, in every way, to stop all unnecessary cruelty to animals; but it remains yet to be proved that shooting pigeons comes under that head; and though the society is very strong in England and on the European continent, yet they have so far utterly failed to prove their case against pigeon shooting, though they have tried again and again to do so, and pigeon shooting is legal, and flourishes over there still.

Pigeon shooting is a popular amusement in America, and is here looked upon as an amusement only; in other countries it is carried on, not so much for amusement, as for the sake of the



A CHANCE OF A DOUBLE.

betting, which is an almost invariable accompaniment of this form of sport. I have myself at various times seen as much as five thousand dollars bet by one man on the result of a single shot.

It is not, therefore, surprising that when so much money is at stake, men who indulge in this sport should be willing to spend large sums of money and much time in getting guns and ammunition that are the best that can be procured. The cost of a gun and equipment is nothing in comparison to the value of the prizes shot for, or the money which a shooter may win or lose in backing himself during a single afternoon's shooting.

Whilst there is a great deal of pigeon shooting in America, it is not carried to anything like the extent that it is in England, France, Belgium, Italy, etc. In those countries, however, it is strictly confined to the wealthy classes, whilst in this country all classes alike take part in it. In America, pigeons can usually be provided at a cost to the shooter of not more than twenty-five cents each, whereas in England the price paid is considerably more than double that amount. The birds in England, however, are much stronger and faster than any that can be procured on this

continent, and though the fast English blue-rock has been imported into this country in considerable numbers by lovers of the sport, in the hope of rearing pigeons from that stock, the experiment has invariably failed, owing to difference in climate and the ease with which pigeons in this country can obtain food as compared with the difficulties they have to encounter over there.

In Europe as here a hand-fed blue-rock is too tame, too fat, and too lazy to leave the trap with the lightning-like rapidity of a bird that has been reared, as they usually are there, in places specially built for them, as far removed as possible from any other buildings or from human beings; in fact, where they are practically wild.

Under these conditions the inherent wildness of the birds (and there is no wilder bird than a cliff-bred blue-rock) remains in them, and as they have to seek a precarious living, wherever and on whatever they can find, and in their search for food have to go many miles away from their roosting-place in all weathers and at all seasons, it follows that their bodies keep small and wiry, whilst their wings are abnormally large and strong. Many people imagine that the birds trapped in England and Europe generally are

caught in the caves that they inhabit in the steepest and rockiest cliffs which abound round the coasts of Great Britain and elsewhere, but this is not the case, as it would be impossible to catch those birds in any numbers.

To give an idea of the difference in the rapidity of flight of the birds trapped in England and those trapped in this country, it is only necessary to mention that whereas in this country if, as is sometimes the case, there is any betting at all, it is usually at the odds of anything from six to one to ten to one laid on the shooter, provided he is a good pigeon shot; in England the odds on the same class of shooter would not be one-half those mentioned, and the man backing the gun would then probably be a loser.

The handling of the pigeons before and while being trapped in England is much better as a rule than in this country, and that alone makes a vast difference in the way in which the birds fly when the trap is sprung. In England all pigeons for trap-shooting are supplied on the morning of the same day on which they are to be used by one or other of two or three concerns who make a regular business of supplying not only the birds, but the men to trap and the dogs to retrieve them.

These pigeon purveyors, from years of practice, are very clever in handling the birds, and have large, airy cages to keep them in until taken to the ground where they are to be trapped. The birds arrive fit to fly for their lives, having invariably been just caught up. Each bird as he was caught was examined, and if not strong and healthy was put back; the rest had their tail feathers squared off with a pair of shears so that whilst confined in a basket or coop their tails would not become dirty or ruffled from the other birds treading on them, and so retard them in their flight.

The matter of food and water is most carefully attended to so that the birds are neither surfeited with overfeeding nor yet faint from want of food or water: each bird is in the pink of condition.

When trapping them, there is no rough handling; the utmost care is taken not to injure them when being lifted out of the baskets, nor to hold them in the hand one moment more than is necessary. In cold or wet weather, after the trapper takes the bird from the coop, he will hold it inside his jacket or under his arm, so as to keep it warm and dry. Whilst in the coops they are guarded from wet, cold, or too much sun. In this

country none of these matters is sufficiently attended to, and it is no uncommon occurrence to see birds brought to a shooting ground or used at some club, which, from their appearance beforehand, are palpably unfit to fly, or even if they look fit and strong do not fly with any vigor, because those in charge of them have not known how to handle them properly.

There is no doubt that great cruelty was practised on pigeons in former days, with the mistaken idea of making the birds fly faster; but this has all been given up, as those handling them have found out that no bird flies so fast as one that is feeling well and strong and has had no tricks played with it. Every pigeon shooter should do his utmost at all times to stop anything approaching cruelty in handling the birds. There is no cruelty in clipping the tail feathers as above described, but all attempts to maltreat the birds should be met with condign punishment whenever discovered.

Wounded birds should be caught and despatched as speedily as possible, and it is a shame ever to allow such a thing as a wounded bird to remain anywhere within reach without putting an end to it either by shooting or otherwise.

With regard to this, the usual plan of retrieving now is far better than formerly. It was usual to allow three, or sometimes more, minutes in which a wounded bird could be gathered. If not gathered within that time limit, it became a "lost bird." The rule now generally adopted is that the moment a bird has been shot at and has touched the ground, the dog is let go to retrieve it; or where there is no dog, the man is to go straight up to the bird and catch it if possible, but not to lose time in going round it or waiting for it to die. Not only does this plan do away with one of the strongest arguments which is used by the Society for the Prevention of Cruelty to Animals, but it makes the shooting quicker and prevents vexatious delays.

The chief difference between shooting pigeons from traps and shooting clay targets lies in the fact that the clay target leaves the trap so fast that it is impossible to hit it with any degree of certainty until it has got some distance from the trap, also that you only have the use of one barrel.

With live birds, on the contrary, the very time to shoot is as they leave the trap and before they have attained their fastest flight, especially as,

having the use of two barrels, you should be in a position to use the second before the bird has got too close to the boundary.

Nothing but practice, and plenty of it, will enable a man time after time to pitch his gun to the right spot so as to catch the pigeon on his first spring, but it is wonderful what practice will do in this as in most things.

When a man faces the five traps, he should take care that he has got the whole five in his full sight, and on giving the signal to the puller to open a trap he should watch for the first sign of a trap moving, not wait till it is open and the bird has left it, but have the muzzle of his gun pointing a little over that particular trap before it is fully open, and as the bird springs he then instinctively points his gun just ahead of the direction it is flying in and pulls the trigger; he must not pause to take aim, but trust to that instinctive working together of brain, eye, and hand, without which a man can never excel as a pigeon shot.

Having fired the first barrel, he should use his judgment as to whether he rattles in the second without a pause or uses it deliberately.

In the case of a bird flying directly toward the

boundary, especially when, as is now so often the case, that is a very short distance from the trap, there is no time to pause, or the bird will have either reached it or got so close to it that, even if killed with the second barrel, it may drop beyond. If, however, the bird circles round or, being wounded, is on the ground, it is better to be deliberate with the second barrel.

It is a golden rule with pigeon shots that a bird is never dead till it is gathered, therefore don't trust to appearances, but make sure that you centre your pigeon with the second barrel.

Any old pigeon shot can tell of numerous cases where birds, apparently as dead as any bird could be, had suddenly taken wing and escaped over the boundary. Also, do not imagine that, because the bird is on the ground, only a short distance from you, that you cannot miss it, especially if you are using a very straight gun; for then, unless you aim at its feet, your shot will all pass over its head. But with any kind of gun it is strangely easy, if the shooter does not take great pains to aim as if he were shooting with a rifle, to shoot a little to one side or the other, or too high or too low.

I remember one extraordinary exemplification

of this at the Westminster Kennel Club, when a match between two of the best amateur pigeon shots in America was taking place, at two hundred pigeons each man, for one thousand dollars a side. One of the contestants, in his first one hundred birds, had three of them, after they had been fired at with the first barrel, light on the ground, giving him an easy stationary object to shoot at with his second, not more than thirty yards off; but in each case he missed, and the bird escaped. Yet this man was a good wing shot, either at the traps or in the field.

This is especially likely to happen if there is a strong cross wind blowing, for the whole charge of shot may then be drifted by the wind to one side or the other, if you have not thought of, and made allowance for, such a contingency.

It is not difficult for a man to become a good pigeon shot if he will take the trouble to learn the chief points about it from any one who has himself learned it all, and then give himself plenty of practice, striving to find out where he is weak, and using every effort to overcome that one weak point which so many shooters have.

He must have plenty of nerve, or the knowledge that he is watched closely by so many others, and

his every movement criticised, will affect his shooting. Some people, however, shoot much better when they are keyed up by the presence of a crowd; it acts as a stimulant, and makes them feel keener than if alone.

In pigeon shooting, whether you are shooting a match or merely a sweepstake, a single bird missed so constantly means the loss of the match or sweep, that each bird shot at must be given all the care and attention that you would give to the last shot in a match, when the result depended upon your killing that one bird. Keep cool, and never allow yourself to be upset or put out by anything that may happen. If a miss comes, take it philosophically. They will come, but do not lose your temper, and blame your gun, or shells, or anything but your own want of holding straight. Note in what direction the bird was flying when you missed it, and which trap it came out of, so as to discover your weak point as soon as possible and take measures to correct it. If you go on missing and cannot account for it, get some experienced shot, whom you can trust, to stand behind you as you shoot and tell you what you did wrong. It is not difficult, if a man is in the right position at your back, for him to see whether, at the

moment of firing, you stopped the swing of your gun, or pulled it down, or shot in front of, behind, over, or under your bird.

I have already written on the most suitable gun for pigeon shooting, so there is no need to repeat it here.

The size of shot best for pigeon shooting is generally allowed to be No. 7. Under exceptional circumstances, such as a gale of wind blowing, it may be well to use No. 6, chiefly because the larger size of shot will drift less with the force of the wind than the smaller; but the larger your shot, the smaller your killing circle. On the other hand, the smaller your shot, the less the absolute killing power, just as it has been found with the modern small-bore rifles, which have penetration enough to go through the body of a man after passing through a moderate-sized tree, yet even then leave him able to shoot back at you unless he has been hit in a vital spot. So it is with small shot; your bird may die, and that very speedily, but yet have vitality enough left to get beyond the boundary. In England the various sizes of shot are numbered differently to what they are here, and our No. 7 is the same as their No. 6.

Pigeon shooting and game shooting are so dif-

ferent that you cannot make them alike. To be a first-class pigeon shot, a man must be able to concentrate all his thought and energy on the work he is doing. Good luck or bad luck must make no difference to him; he must not be easily cast down or easily elated. Nothing brings out the points of a man's character more than pigeon shooting. If he has a weak spot it is sure, sooner or later, to come to the front. The niggardly man, the selfish man, the bad-tempered kicker, and, above all, the crooked man, will surely come to grief; but the nervy, high-principled, hearty good fellow who can give and take, and enjoy life and good-fellowship, will find few ways of enjoying his leisure time more than in competing with others like himself at the traps. Man is a gregarious animal, and likes companionship; therefore the company of fellow-shooters makes pigeon shooting appeal to many. Besides, the season for game shooting is short, and often one is unable to devote the necessary time to it, whereas an afternoon's shoot at pigeons takes little time and requires no preparation.

Then, too, many men are not physically fitted for game shooting and its attendant fatigue. Bad health, advanced years, stoutness, lameness, etc.,

incapacitate a man from game shooting who would otherwise be devoted to it.

To such I say, try pigeon shooting. Give it a good, thorough trial. In your early efforts don't be discouraged if it seems at first too hard; it only wants practice. Make it a sport, and not an art; try to help your neighbor to succeed. In sweep-stake shooting always be willing to divide with another man, whether you think you can beat him or not, when he and you are left in it alone. Never watch for an unfair advantage over an adversary, and if it offers, don't take it. If a disputed point arises, leave the decision to any unbiassed brother sportsman, and then cheerfully abide by his decision.

I have before remarked, that to be a good pigeon shot a man must concentrate his mind on each shot he fires. This is so much the case and so well known among trap-shooters that if a loose pigeon is flying over the ground, or any little thing is happening which might, in the slightest degree, take off the attention of the man at the score, he will wait until it has ceased. The extent to which some crack shots carry this seems ludicrous, and yet perhaps they are right. Some men will not shoot if an empty shell or a piece of paper

is lying on the platform in front of them. I think I am as free from what might be termed fancies as any one, and yet I am aware that I have missed many shots from one thing or another quite as slight, — something catching my eye and disturbing my attention at the moment of calling "Pull."

Nearly all shooters have their special fads and fancies, but I think the most curious I ever met with was a man who would never shoot, no matter what the weather, without wearing a pair of rubber shoes, to give him, as he said, a good grip of the ground. This man is a very fine shot at the traps and in the field, and is by no means finical.

Another man whom I know, and than whom no finer shot exists in America, will, before every shot, slightly raise his hat from his head and replace it again. Others breathe upon their hands to give them a firmer grip of the gun; some wipe their hands for the same reason; some think they can only shoot well in a thin-soled pair of boots; others believe in wearing thick soles, and so on.

Now, are these mere fancies? There is generally something in them, and, at all events, if a man has a fancy, he would better humor it, for nothing is so necessary for good, effective shooting

as for a man to feel that his gun, his ammunition, and everything about him, including himself, are right.

Absolute freedom for the arms and a firm bed for the butt of the gun are very essential. Starched shirt fronts, brace buckles coming on the shoulder where the butt of the gun will rest, a coat which is so loose that it will wrinkle differently each time the gun is thrown up, or, on the other hand, one that in any way holds the arm, or a waistcoat which is not cut out enough at the arms and catches them as the gun comes up to the firing position, are all causes for poor shooting.

Most men shoot better at one part of the day than at another, some best in the morning, others in the afternoon, and so on, showing, I think, that good shooting is often a question of good digestion and affected by a man's habits with regard to eating and drinking. As a rule, I think most men shoot well on a comparatively empty stomach, but this is by no means always the case; some men also require a little stimulant, some a good deal; some do best with none at all.

The position which different men assume at the traps varies, and some are ridiculously awkward and constrained.

A man's position at the traps should be perfectly free and unconstrained.

It is easier for a right-handed shooter to swing his gun to the left than to the right, therefore the left shoulder and left leg should be in advance, the left knee very slightly bent, and the body slightly inclined forward, so as to resist the recoil of the first barrel and prevent the shooter being thrown off his balance. The right knee should be straight.

The gun must be firmly grasped with both hands, the left holding the barrels just in front of the fore end, the right grasping the small of butt, but kept well back so as to get a lateral pull on the trigger in place of an upward pressure, the reason for this being, that whereas with a lateral pull on the trigger the pressure required to fire the gun will not be more than three or four pounds, with an upward pull as much as six or seven pounds pressure may be needed, and this increased weight of pull may cause the shooter to depress his gun at the moment of firing or to flinch, and in either case a miss is likely to result.

Since the rule as to holding gun to shoulder before calling "Pull" has been changed there has been great variety of opinion amongst the best

shots as to which position is best, but the majority are in favor of keeping the stock fully up to the shoulder when sighting the gun previous to calling "Pull," whilst the remainder hold the gun not more than two or three inches below the top of the shoulder, and even then they raise it before the bird is on the wing, or, in the case of clay-target shooting, before they have sighted the target.

Some people when about to shoot a pigeon match think it necessary to go through a course of training for some days previous.

I believe this to be a mistake, and could name several instances that have come under my personal observation where men by departing from their usual everyday routine of life, especially as regards eating and drinking, have shot much below their average.

There is nothing fatiguing to a man in good health in shooting one hundred shots in alternation with his antagonist, especially if, as is usual, he sits down whilst his antagonist takes his place at the traps.

As to taking food or stimulant before or during a match it is impossible to lay down any rule; what suits one man is another man's poison; but as a general rule I think a little stimulant both

before and whilst the match is in progress is beneficial and helps to keep the nerves quiet and to make the hand and eye work quickly and in perfect unison.

Once more I would say, do not be content with simply bringing your bird down and gathering it. It is true it counts as a dead bird on your score, but never be satisfied with any shot you make unless you are sure you had the bird in the very centre of your charge.

In nine out of ten crossing shots the birds, even though gathered, are shot with the outer edge of the charge and not with the centre. Don't be afraid of shooting too far ahead, it is much easier to miss by shooting behind. A crossing bird at forty yards struck with the centre of the charge, when a proper load and a proper pigeon gun is used, will double up and fall stone dead.

A man who finds no fault with himself, as bird after bird falls only partially killed, will soon miss one and then perhaps several in succession. He will wonder why he is doing so, and think he is holding the same as when he was killing. So he is, *almost*, but not quite. At first he was getting his birds with the outside of the charge only, but later he failed to do even that. At first he was

not leading enough, later he was leading still less.

To get a big lead on a pigeon, provided you are keeping up your swing, *i.e.* that the muzzle of your gun is following the exact flight of the bird, it is only necessary to move the muzzle very slightly indeed, much less than most people suppose. For instance, at an object forty yards away from you it is only necessary to deflect the muzzle three inches to make the body of the shot strike eight feet higher, lower, to right or left, as the case may be.

In connection with this, don't forget that I have before called attention to the fact that a bird crossing you at right angles flying at the *slow* rate of forty miles an hour and forty yards away will fly eight feet during the interval of time that will elapse between your pulling the trigger and the instant that the shot will reach the point he is passing. Putting these two facts together and bearing them in your mind will be of great assistance to you in pigeon shooting. Only remember that forty miles an hour is the rate of speed of an ordinary crow, or perhaps I should say a crow under ordinary conditions, but the word seems really to fit the bird so well I feel inclined to leave

it there. A pigeon usually flies very much faster, probably more than sixty miles an hour, up to eighty or ninety under special conditions.

I cannot lay too much stress upon the necessity of being able to use the first barrel with lightning-like rapidity and following with the second after scarcely an appreciable pause. This is not always necessary or even advisable, but it is absolutely necessary with some birds and under certain conditions, such as a gale of wind, an extremely short boundary, or an unusually fast bird.

Nothing shows the difference between a good and an indifferent pigeon shot more than the ability the first will display in judging the right time in which to shoot. A beginner is almost certain, when an extra fast bird leaves the trap, to be slower in using his first barrel, at all events, than he would have been had the bird not been so quick on the wing; whilst the experienced shot will be quicker than usual on that description of bird.

In the winter of 1893–94 a picked team of the best four amateurs of New York challenged an equal number of Philadelphia amateurs to shoot a match at the traps. The challenge was promptly accepted by the Riverton Club, of Philadelphia,

who named as a team four men who were then shooting in wonderful form and had carried everything before them. These were Charles Macalester, Yale Dolan, Tom Dando, and Bob Welch, all members of the Riverton Club, where the first match was to be shot.

It would be hard to find four men in America, or anywhere else, who would have felt at all confident of beating these men, either singly or as a team. They were all, comparatively speaking, though not old in years, yet old as pigeon shots, and two, at least, had made their record in Europe; but they were all what would be termed deliberate shots at that time. The day of the match the two teams journeyed down together by train from Philadelphia to Riverton, and there was such a terrific gale blowing that it easily rocked the carriages on the rails. When we reached the ground, which is very exposed, branches of trees and shingles off the roof of the club house were flying in all directions. The boundary was twenty-one yards, and consisted of a three-foot wire fence. The wind was directly behind the birds, which were an exceptionally fast lot, and made them all out-goers; each man was to shoot at fifty birds.

The New York team consisted of the late

George Work, Edgar Murphy, Fred Hoey, and myself, and without an exception we were all quick shots and all shot throughout the match, which lasted a long time, in the same quick style, letting the first barrel off as the bird left the trap, and never pausing on the second. The consequence was that our score was a long way ahead of theirs before many rounds had been shot and that we won easily. A return match was shot, a few weeks later, at the Westminster Kennel Club grounds, Babylon, L. I., between the same two teams, when, fortunately for the New York team, a high wind, though not this time a gale, was again blowing directly behind the birds, and again we scored a victory. I have mentioned this to show that, under these exceptional conditions, the men who could shoot quickest were the winners, though had the conditions been reversed, it would have been hard to pick the winning team.

Always be on your guard when pigeon shooting against acquiring some bad habit; you may do this without being aware of it, unless on the watch; such as leaning too much forward, a common habit, acquired from a too great eagerness to be quick on your bird, or getting into a ner-

vous, jerky way of throwing the gun to the shoulder; or, on the other hand, growing too deliberate with either barrel, or too snappy; equally bad faults, which must be guarded against, day by day, as long as a man is a pigeon shooter.

Some Useful General Hints

It often happens to a man when shooting or returning home after a day's shooting that he would be glad to sling his gun over his back, so as to leave his hands free.

It may be his hands are so cold that he would like to keep them in his pockets, or he wants to carry something else in his hands, or light his pipe, etc.

When shooting I always carry in my pocket a stout piece of cord, with the ends tied securely, just long enough to pass loosely over the head and right shoulder and arm, so that it hangs down on the right side in a loop.

Pass the stock of your gun through the loop, muzzle to the front and downward, so that the cord catches behind the trigger guard. The gun, hanging like this, is perfectly safe, and leaves the hands free.

I have used this device both on horseback and bicycle, and can strongly recommend it.

This same piece of cord often comes in handy for other purposes, such as temporarily fastening up a dog, etc.

Never go into the brush without a stout knife in your pocket; you never know when you may need it.

The ejector may pass over the head of a shell and you want to cut a stick to force the shell out. You may want to build a fire, but can find nothing but damp wood; then you can slice enough *inside* wood to start the fire, and the rest is easy.

I make it a rule before starting out shooting to run over in my mind the articles I never go without, to make sure that I have them: —

(1) Gun.
(2) Ammunition.
(3) Flask.
(4) Matches.
(5) Gun carrier (string).
(6) Knife.
(7) Dog whistle.

And I have found this very useful.

Use and Abuse of Smokeless Powder

Smokeless powders have been in use for about twenty-five years, and yet the average sportsman knows very little about the powder his shells are loaded with, its properties, or why it does its work, or where possible danger lies in its use. That there are fewer accidents to guns, or to those using them, from modern smokeless powders than used formerly to be the case, when only black powder was used, is a well-established fact, but if the people knew more about the action of the powder they are using, and of its properties, many of the accidents which are of constant occurrence would be avoided.

In the charge of smokeless powder which is in your gun when it is loaded, no matter how small that may be, you have an element of danger in the powder itself, if due care has not been taken in loading the shells you are using. Properly handled, as has been said before, it is safer than its equivalent in black powder.

This element of danger arises from the fact that all nitro powders, without any exception, can be made to detonate.

This term "detonate" means that the powder

has been so completely and thoroughly ignited that it evolves all its gases in one instantaneous moment, with such extraordinary rapidity that any solid substance it is in actual contact with is shattered all to pieces.

So that, for example, a comparatively small quantity of nitro powder lying on a slab of rock, and ignited in this way, would make a hole in the rock, although there was nothing to confine it in any other direction.

But to do this the powder would have to be in contact with a most powerful detonating explosive, such as fifty grains of fulminate of mercury, whereas the ordinary quantity of that fulminate in a shell is one-quarter grain.

To understand this thoroughly it should be borne in mind that all fire is a form of explosion.

A stick of wood or a piece of coal or a simple match burning is exploding; that is to say, it is changing from a solid mass to gas, but the gases are not being released, owing to the slow combustion that is taking place, with sufficient rapidity to cause what is usually termed an explosion.

So far as I know, there has been nothing written since the first smokeless powders came into use which has conveyed to the shooter any real

information as to the actual difference between the old black powder and the various nitro compounds which have taken its place.

For want of this knowledge there has been much misconception as to how shells should be properly loaded, and shooters have had furnished to them at times shells which had no proper force, or, on the other hand, shells which were positively dangerous to use.

Between these two extremes there is a wide distance, and the shooter should take care that he always has his shells so loaded that he hits the happy medium, that is, that he has in his gun a shell which is perfectly safe to use and which yet will give him the highest velocity combined with the best possible pattern and no undue recoil.

Black powder, noisy, smoky, and bad smelling, had been in use so long that every one knew how it should be handled, but how many sportsmen at the present time know all the peculiarities of smokeless powders, how to get the best results, and how to avoid any possible danger in their use?

These powders differ very materially from black powder, not only in little or no smoke resulting from their ignition, but in the extreme sensitiveness of the material of which they are composed

to the way in which it is ignited, and the conditions under which the ignition takes place.

If black powder is ignited, either by a match, a percussion cap, a spark of electricity, or by direct heat, it at once explodes with more or less violence, according to how closely it is confined; that is to say, if you place black gunpowder on a plate and touch it with a spark, etc., it goes off with a puff, but makes no report and exerts no great force because there is plenty of space for the gas to escape into. If confined closely in a cartridge and fired in the same way, it makes a loud report and exerts a considerable amount of pressure.

Nitro powder, on the other hand, will not ignite when only a small spark or low degree of heat is applied, but is far more sensitive to the effects of various degrees of heat when these are high and strong. Thus, if some black powder were placed upon one plate and an equal quantity of smokeless powder on another, and a very minute spark applied to each in turn, the black would ignite, but the smokeless would not.

If the same conditions were observed, but a stronger ignition applied, the black powder would burn in the same way as before, that is, it would all go off together in one quick puff, whilst the

nitro powder would now ignite, but would burn slowly and even leave some particles unburned on the plate.

Now confine both of these powders in a properly loaded shell and place them in a gun and apply a still more powerful ignition, such as the cap employed to explode an ordinary shell, which not only gives a hot flash, but drives the same through the entire charge; you will get an explosion of about the same force in both cases, but it will be of that gradual form that it will drive the shot out of the gun with an amount of velocity which will be the same, according to the charge used, in black as in smokeless.

But if you again increased very much the power of your igniting agent by using a cap containing a much larger quantity of fulminate of mercury, etc., you now get very different results from the two powders. The black powder cartridge will give the same or nearly the same result as before, but the nitro powder will probably burn with such enormously increased velocity that it has no time to find an exit for its rapidly forming gases, and such pressure will be exerted in every direction that the gun will burst.

When this happens the powder is said to have

detonated; in other words, it has all burned up in one moment of time, in place of a gradual combustion taking place.

I have before mentioned the large quantity of a detonating agent, such as fulminate of mercury, which is required to make a *loose* mass of powder detonate; but when nitro powder is closely confined in a shell and that placed in the barrel of a gun so as further to confine it, only a small amount of such detonating agent in excess of what is usually used would be required to make the powder in that shell detonate.

I have endeavored to show that nitro powder differs materially from black, and requires special and careful treatment to get the best results without risk of accident.

No one is more alive to this fact than the manufacturer of the powder. He can at will make a powder which is slower or faster in its initial ignition, and when ignited will burn slower or faster, as is most advisable. His object is to make a powder which will always act the same under given conditions, and under these conditions will give the greatest possible velocity without sacrificing the pattern. He has to make his powder suit the ordinary requirements of the shell loader,

and therefore in the experiments which are always made at every powder factory with each batch of powder before it is issued, to see that it is fully up to standard, he uses such a shell and such wadding as is generally in use, and the same with the amount of pressure put on the powder and the amount of crimp in the turn-over.

Some shell loaders, however, especially if they have none of the mechanical appliances for testing at command which every powder maker has, think that they know a great deal more about how to load shells than any one else, and load their shells to suit their own fancy, believing that they are getting a better result by doing so, but entirely ignorant of the fact that, the powder having been specially made to suit a different set of conditions, they are either sacrificing pattern to increased velocity or velocity to pattern, or they may even be running the risk of setting up a dangerous amount of pressure in the breech of the gun.

The powder maker knows what the shooter often does not, viz., that extra hard wadding will make the powder burn too fast to give the best results; that if extra pressure is put on the powder the same thing occurs; that if the turn-over is unduly stiff it will also affect the discharge, though

to a less extent, in the same way; but if all these three are done to one and the same shell, then a violent action is set up, — there is more recoil, louder report, more lateral pressure on the chambers of the gun, and the danger point is not far off.

This too rapid action is further increased if, as some people still do, a priming of black powder is put into the shell before the charge of nitro powder, or, worse still, if two kinds of nitro powder are put in the same shell, which I have known to be done repeatedly, with the consequent result of the bursting of several guns.

The lesson to be learned by the shooter is, that whatever powder he is using he must have it loaded according to the directions issued by the powder manufacturers, and not according to individual whim and fancy.

THE HUNTING RIFLE

By Horace Kephart

THE HUNTING RIFLE

A RIFLE for big game should shoot accurately, with low trajectory, and it should strike a knock-out blow. Its mechanism should be safe, simple, and positive; its trigger-pull, smooth and easy; its sights, strong, firmly fitted, and so adjusted to the eye that they will not blur. The stock must be strong, especially in the grip, and it should fit the user. The gun should not be heavier, at most, than a military rifle; but the recoil should be moderate, and the barrel stiff enough not to jump or flip excessively.

Many sportsmen would go no farther than this in their specifications; but to my mind there is one more quality that a hunting rifle ought to have: it should be capable of using cheap and accurate ammunition suitable for small game and target practice, so that its owner, by frequent practice near home, may become expert in the use of his weapon.

It is not possible to have all desirable features, at their best, in one and the same gun. Extreme

accuracy, for example, can only be attained by an inordinately heavy barrel and a weak charge. A "schuetzen" rifle may place shot after shot within an inch of dead centre at 200 yards range, but it is good for nothing but target-shooting. Similarly, we may have a 6 or 7 pound rifle that shoots a charge heavy enough for the largest game, but it is not likely to be accurate, and its recoil will be excessive. A practical hunting rifle is a compromise between qualities that conflict more or less with each other, and one must know where to draw the line between them if one would make sure of getting an all-round good weapon.

Rifle makers turn out a great variety of arms and ammunition, to suit the needs and fancies of sportsmen in all parts of the world. Many of the guns and cartridges that they sell are designed for special purposes, and, while good for the work that they are intended to perform, they cannot be recommended for average hunting. In the following remarks I will keep in mind what seem to be the needs of a majority of hunters of American big game.

I am aware that some of the details here given may seem over finely spun. "Any rifle by a good

maker will shoot closer than the average man can hold." True enough. But I am writing for men who wish to be better than average shots, and who take some pride in superior weapons.

Accuracy

Every rifle should shoot with such precision that its user may be sure that a miss is his own fault. This means that it should drive its bullets as close to the mark as an expert rifleman can hold, under favorable conditions. Such a man would not be satisfied with a rifle unless it could be relied upon to group nearly all its shots in or on a 1-inch circle at 25 yards, 2-inch at 50, 4-inch at 100, 8-inch at 200, and 12-inch at 300 yards. He might not expect to use it at longer ranges; but if the rifle were sure of the standard bull's-eye at 500 yards, he would like it all the better.

Men whose hunting is confined to thickly timbered regions may be content with a lower standard of accuracy than this; but I do not think it too much to expect of a weapon for all-round work, to be used on the plains and mountains, as well as in woods and swamps. I do not wish, however, to be understood as counselling any one

to risk long shots when there is a reasonable chance of getting nearer. By a long shot I mean anything beyond 150 yards. The notion that improved weapons have more than doubled the distance at which sure shots can be made at game is a delusion. We read in newspapers that a modern military rifle can kill a man two miles away, and this is true; but we do not read, what is equally true, that the best of marksmen would do well to hit a 40-acre field at that distance, under service conditions. Similarly with hunting rifles, only much "more so": the trajectory of the bullet, the difficulty of judging distances with precision, the neutral color of the mark blending with the background, the movements of the game, the intervention of trees or brush, and many other obstacles, often make long shots futile. None the less, a rifle should shoot with accuracy to a considerably greater distance than it will be used in fair hunting; because, if it does not, it is not likely to prove accurate at shorter distances, particularly when wind is blowing.

The shooting qualities of a rifle depend, for the most part, on its barrel, and how it is loaded. So far as material and workmanship go, the barrels of all reputable makers are reliable.

But mistakes are sometimes made in designing them — usually in response to a popular demand that is not always infallible. For example, a rifle barrel may be too thin and springy to shoot accurately the charge for which it is chambered. A thin barrel, if heavily loaded, is likely to jump or flip when discharged. What these terms mean is defined by Mr. Carlin in another part of this book. The jump or flip may be fairly constant with a given charge. In that case, the sights can be adjusted to allow for it, and this is usually done at the factory. Then the purchaser will not detect any fault in his gun so long as he uses the standard charge; but if he tries a reduced load, or perhaps a batch of cartridges of some other make, he will be puzzled and annoyed by the extraordinary antics of his gun, which will shoot several inches to one side, or higher or lower, than in all reason it should, as though possessed by an imp. The barrels of most military rifles of modern type are longer and thinner than they should be. The Krag, for instance, when shot at 70 yards with suitable reduced loads, requires an elevation of from 325 to 420 yards on the rear sight, and an allowance of from 1 to $1\frac{1}{4}$

points left windage. This is not due to any great difference in trajectory between the reduced and the service charge, at this short range, but to what Dr. Hudson calls the "terrific whip" of the barrel when fired with service charge, and to the correction made for it on the rear sight. I have often noticed similar results from changing ammunition in light hunting rifles. On the other hand, I have had a single-shot Winchester .30–40–220 with No. 3 round barrel which shot both full charges and reduced charges with accuracy and with no change of alignment, the elevation being shifted no more than the trajectories required. A Remington-Lee of the same caliber, which I had made to order with slowly tapered barrel, although weighing only a fraction over 8 pounds, was similarly stiff and reliable. The maker's brand has nothing to do with this; it is merely a question of thickness of barrel.

In our reaction from the unnecessarily heavy rifles formerly in vogue, we are tempted to go to the opposite extreme. Smokeless powder exerts most of its pressure in the chamber of the rifle and a couple of inches in front of it; consequently all of the barrel forward of this may

STANDING THEM OFF.

be made quite thin, and yet be safe. But such a barrel is objectionable, not only because of its tendency to flip, but because it is too sensitive to varying conditions of heat from rapid firing, fouling, etc., and hence does not shoot so steadily as a thicker barrel. Another bad feature of such a barrel is that it requires a very high front sight, which is likely to cause overshooting when one aims quickly or in bad light, and is also more apt to get knocked out of alignment than a low sight. If weight must be trimmed down, and none can be spared from other parts of the gun, the barrel should be made short, with gradual taper from breech to muzzle, the front sight being set low on the barrel. A 24-inch barrel is long enough for a magazine rifle.

The character and distribution of breech mechanism and the bend and stoutness of stock have something to do with a rifle's shooting qualities, but not enough to be considered here.

The chief factor in a rifle's accuracy is its ammunition. In these days the "make" of a rifle is of less consequence than the choice of a cartridge. It is much more to the point for a rifleman to study the differences between, let us say, a .30–30–160 and a .30–40–220, than to

argue the respective merits of a Winchester, Marlin, Männlicher, Remington, Savage, Stevens, or what not. This will sound like heresy to many novices, and to some old marksmen, but it is a fact capable of demonstration. First choose a cartridge; then a gun to handle it.

If the reader will pardon a slight digression, I will say here that the subject of breech mechanisms, if thoroughly treated, would require a volume. I have only space to call attention to a few general principles that should be borne in mind when making a choice. As for materials and workmanship, if one is not himself a good judge, he should consult some one who is. Any good mechanic can immediately detect malleable forgings or faulty finish. Cheap guns may be made to look well on the outside, though their essential working parts may be of soft or brittle metal and roughly finished. See that the bolt or breech-block is capable of pushing into the chamber a shell that protrudes a little because it is slightly over size. A more important matter is the extracting mechanism. This must be of strong material and powerful action. Some rifles, particularly single-shot weapons, are defective in this respect. In a repeating rifle, test the feed of

cartridges from magazine to chamber, holding the gun in various positions. If there is any tendency to jam, reject the gun at once. Pay especial attention to this matter in a rifle with tubular magazine. Be sure that the trigger-pull is smooth and positive, not " creepy " or irregular. Other things being equal, a bolt-action gun is stronger, and has simpler mechanism than one operated by a lever; but it is more awkward to fire rapidly. It is decidedly advantageous to have a rifle the mechanism of which can be dismounted without a screw-driver or other tool. The fewer the parts and the more easily they are dismounted and assembled, the better. Some rifle actions are so complicated that, if anything goes wrong with them, it may take a hunter an hour or more to take them apart and put them together again. Remember that rifles for big game are to be used in regions remote from gunsmiths; that your only tool may be a screw-driver; and that even it may be reposing at the bottom of some creek or snow-drift.

The accuracy or inaccuracy of ammunition can only be determined by experiment. Yet there are a few general principles that may aid one in the selection of a cartridge.

Smokeless powder, formerly very bad, has at last been improved, until we have one or two brands that are as reliable as black gunpowder. Since smokeless powder has unquestionable advantages, I will here assume that black powder is obsolete.

Bullets for high-power rifles are not always what they should be. The shape and fit of mantled bullets are of the utmost concern to a marksman. Here we may lay down a few rules of thumb that will be found to work well in practice.

1. An ill-proportioned or misshapen bullet will be more erratic when flying at high velocity than when moving slowly.

2. Bullets with hollow points are likely to "corkscrew" (drift spirally), and have a tendency to tumble and "keyhole," unless they are long and have shallow holes.

3. Bullets with split points are liable to open prematurely and fly wild.

4. Accuracy at 200 yards and upwards is not to be expected of any bullets that are shorter than

3 times their caliber, for .25 caliber bullets,
2½ times their caliber, for .30 to .35 caliber bullets,

2 times their caliber, for .40 to .45 caliber bullets,
$1\frac{3}{4}$ times their caliber, for .50 caliber bullets.[1]

5. A mantled bullet does not upset from the force of explosion; consequently it must be large enough to fill the grooves of the rifling completely, so that no gas can escape past it; otherwise its flight will be unsteady. So small a deficiency in diameter as a thousandth of an inch will work mischief, and will cause a good rifle to be condemned when the only fault is a loose bullet. Since rifle barrels are not bored with absolute uniformity (differences of several thousandths of an inch being sometimes found in barrels that are supposedly of the same cali-

[1] Bullets should not be lighter than the following, unless used at shorter ranges than 200 yards: —

.25 caliber, 115 grains	.40 caliber, 300 grains
.30 caliber, 160 grains	.45 caliber, 350 grains
.32 caliber, 165 grains	.50 caliber, 400 grains
.38 caliber, 250 grains	

In .25, .30, and .32 caliber the weight may well be greater, but in larger calibers it cannot be increased much without excessive recoil, if charges giving upwards of 1800 feet a second velocity are used.

Such cartridges as the .38–40–180, .44–40–200, and .50–110–300, which have bullets of only $1\frac{1}{3}$ to $1\frac{1}{2}$ calibers length, are not reliable beyond 150 yards. The .45–70–300 and .45–90–300, with bullets of $1\frac{3}{4}$ calibers length, are of doubtful accuracy beyond 200 yards, and their drift is quite noticeable; an extra 50 grains of lead improves them, but increases both pressure and recoil.

ber), nor are mantled bullets made of precisely uniform diameter, the bullets should be made a shade larger than the distance between grooves of the rifling. Marked improvement in the shooting of our Krag rifles has followed the use of super-caliber bullets. The actual diameter of a bullet is not that of its nominal caliber. The difference is sometimes very marked, as in the .38–40–180, and the .44–40–200, which are of .400 and .424 inch diameter, respectively.

The trouble formerly experienced with small caliber rifles using nitro powder and mantled bullets was mostly due to poor powder and ill-fitting bullets. Improvements have been made within the last year or two, and we now have some rifles and ammunition of high velocity that shoot very accurately. A notable example is the new .32–40–165 H. V. (muzzle velocity somewhat over 2000 feet a second), with which groups of ten consecutive shots can be made in a 4-inch circle at 200 yards, shooting from a common hunting rifle.

Trajectory

Probably not one rifleman in ten ever takes the trouble to test the trajectory of his ammunition;

yet I do not know how a few hours could be spent more profitably by one who wishes to know what his rifle can do, and, even more important, what it cannot do. Misses from shooting over or under the game are more frequent than any others, and they are often caused by misjudging the allowance to be made for the curved flight of the bullet.

Men whose practice with rifles is limited to short range target shooting take no account of trajectories. They merely "find the bull's-eye" by experimental firing, and then take no heed of anything but accuracy at a measured distance. I have a wide acquaintance among target shooters, and have shot with them hundreds of times. Among them are some successful hunters, and some ex-soldiers who know how to allow for distance in shooting over unfamiliar ground; but, as a class, our city target shooters have little or no experience with practical weapons in the field. Many of them are extraordinarily fine shots at known distances — better than nine-tenths of our hunters and soldiers, but they have more to learn about practical marksmanship than the hunters and soldiers have to learn about targets. I have seen a squad of them, after firing at 200 yards

and rarely missing the bull's-eye, suddenly turn their rifles upon an inquisitive rabbit that bobbed up on the range not 50 yards away, and — not a bullet touched it! Not a man in the squad knew how much allowance to make for the rise of the bullet at that short distance, with sights set for a longer range.

Even among experienced hunters there are many who hold very absurd theories about the flight of bullets. The old woodsman who swears that his rifle shoots "dead level" for 200 yards is still with us, and so is the new woodsman who fondly believes the statements of some gun catalogues about shooting "practically point-blank" up to 300 yards.

As a matter of fact, bullets from the best of modern rifles rise from 4 to 6 inches above the line of fire at 100 yards when the rifle is sighted for 200, and from 12 to 18 inches at 150 yards when sighted for 300. This is by no means "practically point-blank." Most shots at big game are made at from 50 to 100 yards, and a bullet flying several inches too high at short range is a bullet badly aimed. I will have more to say about this under the head of "Adjusting for Zero." Meantime the reader is referred to

the trajectory data given in the accompanying table; but with the warning that rifles have their personal equations, and also that trajectories vary according to atmospheric density. In the table no allowance is made for the angle between line of sight and line of fire, which varies according to the height of front sight above axis of bore. Nothing short of actual test of each rifle for itself, by shooting first at one distance, then at another, with the same elevation of rear sight, can teach one what his rifle will do. All of us should do such testing for ourselves.

> "It wad frae monie a blunder free us,
> And foolish notion."

In all kinds of hunting with the rifle a low trajectory is a high merit; but it is the ammunition, not the gun, that gives it.

Killing Power

It is neither humane nor sportsmanlike merely to cripple an animal. Instant death is the true sportsman's motto. So long as we eat meat, the best we can do for our victims is to put them out of the way as quickly and painlessly as possible. For this reason an expanding bullet,

driven at high velocity so as to deliver a smashing, knock-out blow, is not the barbarous missile that some good people think it is. On the contrary, it is the most humane projectile that we can use.

The killing power of a bullet depends upon its weight, velocity, diameter when upset by impact, and its ability to penetrate far enough to strike a vital organ, deal a paralyzing shock to the nerve centres, or exhaust the animal by loss of blood.

The penetration of full-mantled bullets, such as those of military cartridges, is excessive from a hunter's standpoint. A .30 Krag, for example, will shoot through a large tree, or through the length of almost any animal, with little deformation of the bullet. If such a missile strikes an animal through the brain or spinal cord, it will kill; or if it strikes an organ distended by fluid it may, by hydrostatic pressure, produce a bursting effect that kills. But such shots are exceptional. If a bullet of this sort hits the abdominal viscera, the beast will probably run far, and may escape, to die a lingering death. If a bone is hit, it is not likely to be shattered. An animal shot through the soft parts of the body by such

a bullet feels only a sharp sting at the time, as though a whip had been smartly cracked on it. The bullet, piercing easily, expends but a small part of its momentum upon the victim.

Another objection to the use of full-mantled bullets in hunting is that they are not easily stopped by branches of trees, brush, etc., and are dangerous to hunters and others who may be within their range but beyond view of the firer.

The best results are obtained with solid bullets the side and base of which are incased in hard metal, but with the soft lead core left exposed at the point. Such projectiles, known as "soft-points," when properly made are very destructive, as their points expand on impact to much more than their normal diameter, making a large wound and imparting a severe shock. It is essential that such bullets should be driven at high speed in order to upset properly. If a soft-point lodges in an animal, the full force of its momentum is expended upon it. If, on the contrary, it goes clear through the body or limb, its hole of exit will be so large that the beast bleeds freely and is easily trailed. In either case the result is likely to be deadly.

Dissatisfaction with soft-point bullets is sometimes expressed, on the score that they expand too readily, or prematurely fly to pieces, and hence fail to penetrate deeply enough to inflict a mortal wound. If this happens, it is because the mantel was too thin or too soft, or because too much of the lead core was exposed, or because the bullet was too short. As for the latter fault, one should consider it before selecting a rifle. Compare, for example, the .30–30–160 and the .30–40–220, in this respect. If both bullets travel at the same velocity and meet the same obstacle, the former may be turned inside out, or may go to pieces, inflicting only a superficial wound, where the latter, owing to its greater length and weight, and harder envelope, would only mushroom at the point, leaving the long, firmly encased body of the bullet intact, thus ensuring ample penetration. What Van Dyke says in his "Still Hunter" of hollow-point bullets is equally true of soft-points: "Penetration is just as essential as striking surface. . . . If the ball is to penetrate or crush far, it must have momentum. To have momentum, it must have weight. To have weight, it must hold together. . . . There must be weight behind to force the

widening front of an expansive ball through solid flesh, or even through the contents of the stomach."

By firing into a clay bank free from gravel, and digging out the bullets, one can judge fairly well whether the soft-points will merely mushroom, as they should, or will fly to pieces on big-boned animals covered with thick hair and tough hides.

Ever since small-bore rifles began to be used in war and in the chase, there has been a lively discussion as to the relative killing powers of large and small calibers. At least, that is the form in which the question is usually put; but it is a loose way of stating the point at issue, and is likely to lead far afield. More than a mere matter of caliber, and more even than killing power, underlies the discussion. If the latter were the only factor to be considered, then nearly every one who went after big game would take a large caliber weapon using ammunition of high velocity, as a matter of course, on the general principle that it is best to err on the safe side.

For the sake of clearness let us assume that by "small-bore" is meant any rifle of less than .33 caliber. It is convenient to draw the line here

because it will include under small-bores all modern military rifles, and all sporting rifles that use military ammunition. The latter are favored by many sportsmen because the cartridges are lighter to carry and easier to procure in unsettled regions than larger ones. There are many riflemen, too, who want what they call "a good all-round rifle," which shoots hard enough to kill big game and yet may be used with satisfaction on small game, or at targets, "to keep one's hand in." Few Americans carry a "battery" of different rifles when they go hunting, no matter how many guns they may own. Such men prefer small-bores if they will do the work.

Killing power depends upon shock and penetration. Shock varies as the energy or momentum that is checked by the victim's body, and the sensitiveness of the part hit. The amount of energy checked depends upon the striking force of the bullet, its striking surface, and the resistance encountered.

At the end of this section will be found a table that I have prepared, giving the ballistic qualities of those smokeless cartridges that are at present most used in America for hunting large game, and of a few black powder cartridges that are in-

troduced for comparison. I call special attention to the fact that this table and the present discussion relate only to ammunition, and not to different makes of rifles. In order clearly to distinguish the various cartridges from each other, it is necessary to give them their factory names, as, for example, .38–55 H. V. Marlin, .38–55 H. V. Winchester, 7 mm. Spanish Mauser, 8 mm. Männlicher, and so on; but these terms do not necessarily denote the rifles from which they are shot. Remington-Lee rifles, for example, are made to use cartridges designated as Remington, Mauser, Männlicher, U.S.A., etc.; some Savage and Stevens rifles use cartridges called Marlin or Winchester; some Marlin and Winchester rifles use ammunition that is interchangeable; individuals sometimes fit a barrel of one make to an action of another make; and so on. The make of rifle cuts practically no figure so far as ballistic qualities are concerned. There may be differences in number and depth of grooves and twist of rifling, but these differences are so slight in the barrels of various makes that *a given cartridge will give practically the same results in all well-made rifles that are bored, chambered, and rifled to use it*, length of barrels being the same.

In the table are given for each cartridge its muzzle energy and the remaining energy of the bullet at 150 yards. These are computed by Mr. Carlin's formulæ. The values of $\frac{d^2}{w}$ are calculated from the actual diameter of the bullet in each case. This often varies considerably from the nominal caliber of the rifle (note, for example, the .35 Winchester, .38–40, .44–40, and .50–110), and it is the only accurate datum. The other figures are furnished by the Winchester, Marlin, and Union Metallic Cartridge companies. I regret that I was not able, at the time the table was compiled, to give the exact figures for the 9 mm. Männlicher and 9 mm. Mauser cartridges. They vary but little from those of the .35 Winchester, which may be considered as typifying them.

Glancing at the "energy" columns of the table, we see at once that caliber alone is no criterion at at all. Here is a cartridge of only .28 caliber that has more energy at all ranges than another of .50 caliber.

Neither is weight any index, by itself, of efficiency. The energy of the 219-grain Mauser bullet of .311 caliber is about the same at the muzzle as that of the 450-grain .50–100 black powder

cartridge, and it quickly gains as the distance increases. The speed and relative length of bullet are very important factors in developing and sustaining energy.

It will be noticed, too, that the penetration of soft-point bullets in pine compares favorably with that of the unsheathed lead bullets used in the large caliber rifles using black powder. In steel it is greater than theirs. Of course, full-mantled bullets of much greater penetration may be used if preferred.

So much for the table. It shows the amount of energy developed, but it cannot show how much is utilized in a given case. That depends largely upon the striking surface and the resistance met. The advantage is generally with a large caliber bullet, unless the missile lodges in its victim and thus spends all of its energy upon it, in which case the bullet of greatest striking energy is the most effective, regardless of caliber.

As regards the expansion of soft-point bullets, I have never personally seen a failure, unless the shooter ignorantly used a reduced charge of powder. When properly loaded they will expand on a rabbit's paunch. Neither have I seen a failure to smash bone, when the bone was fairly struck.

There is, however, some danger of a short and light soft-point failing to penetrate deeply enough after passing through a cushion of thick hair and hide. This is as true of large calibers as of small ones. The remedy is a long, heavy bullet.

Personally, I would not use full-mantled bullets on any American game. The fault of such bullets is that they do not "pulp" enough tissue. There are all sorts of directions in which an animal may be pierced through and through by a non-expanding bullet and seem little the worse for it; but there are comparatively few parts of its body in which a properly expanding bullet will not damage important nerves or blood-vessels, and thus communicate a shock to the whole system that will knock a good deal of the fight out of it.

Yet there are amazing exceptions sometimes. I do not like to go into such details; but this is a technical discussion. Every one who has had much experience in the field has witnessed instances of vitality in wild animals (not speaking of species, but of individuals) that made him doubt his senses — has seen one shot through the brain and still crawl into a den, or another literally disembowelled and yet fight with fury until it dropped

from sheer loss of blood. An animal apparently dead may spring upon the melodramatic greenhorn who approaches to bleed it, and may upset both his calculations and his equilibrium. Hence it is an old maxim among hunters of big game to "shoot till the critter's down, and then put a bullet through its head."

I give below my personal opinions of the relative killing power of the various smokeless cartridges in the table that follows. I never knew any one's opinion in such matters to go unchallenged; but I believe that where I am found to err it will be on the safe side. In ranking the .30 New Springfield among cartridges fit for grizzly bear hunting, I forecast that a reliable expanding bullet will be made for it, which is no great task. The superior ballistics of this cartridge place it in a class by itself as compared with all other smallbores on our list. The grizzly and his big cousin, the Kadiak bear, are formidable brutes — quite as much so, in the opinion of competent judges, as any animals of the Old World; and he who hunts them takes his chances, whatever be the caliber of his weapon. The work calls for a good man behind a good gun.

I would rank the killing power of the following

cartridges about as stated, beginning with the strongest: —

A

For Grizzly Bears. Calibers, .30 *to* .50. *Energies at* 150 *yards,* 1321 *to* 1971 *foot-pounds. Penetration,* 13 *to* 15 *inches.*

.405 Winchester.	.30 Springfield.
9 mm. Mauser.	.50–110 H. V.*
9 mm. Männlicher.	.45–90 H. V.*
.35 Winchester.	8 mm. Männlicher.
	7.65 mm. Mauser.

B

For Moose, Elk, Caribou, etc. Calibers, .30 *to* .45. *Energies at* 150 *yards,* 835 *to* 1297 *foot-pounds. Penetration,* 10 *to* 14 *inches.*

7 mm. Mauser.	.38–55 H. V.
.30 U.S.A. (Krag).	.32–40 H. V.
.303 British (Lee-Metford).	.32 Winchester.
.45–70–300 H. V.*	.303 Savage.
.33 Winchester.	

C

For Deer, Black Bear, Antelope, Sheep, Goats, etc. Calibers, .25 *to* .44. *Energies at* 150 *yards,* 479 *to* 747 *foot-pounds. Penetration,* 9½ *to* 12 *inches.*

.30–30.	.38–40 H. V.*
.25–36.	.44–40 H. V.*
.25–35.	

The cartridges starred (*) are not recommended for shots beyond 150 yards.

It will save a rifleman much trouble and chagrin if, when he buys ammunition, he will

invariably give the full trade name of the cartridge wanted, and personally examine the label of every box that he buys, to make sure that the clerk has made no mistake. It will not do, for example, merely to say, "Give me some .32–40 Marlin smokeless cartridges." There are five different .32–40 Marlin cartridges using smokeless powder, with velocities ranging from 1575 to over 2000 feet a second, — not to mention a dozen other .32–40 cartridges that can be used in the same gun. Especially should one guard against getting low power smokeless ammunition when high velocity cartridges are wanted. Each of these is good in its way, but they cannot be used interchangeably without re-sighting the rifle. Find out by actual test just what cartridge pleases you best; then stick to it, and examine the label on every box of ammunition that you buy.

BALLISTIC DATA OF

(Results are variable, being affected by atmos-

Cartridge	Diameter of Bullet	Weight of Bullet	Value of $\frac{d^2}{w}$	Velocity	
				At Muzzle	At 150 yards
	inch	grains		feet	feet
.25–35 Winchester . . .	.257	117	3.952	1925	1497
.25–36 Marlin	.257	117	3.952	2000	1559
7 mm. Spanish Mauser . .	.2843	173	3.271	2260	1837
.30–30 W. and Marlin. .	.306	160	4.097	1885	1450
.30–40 U.S.A. (Krag) . .	.308	220	3.018	1960	1622
.30 Springfield	.308	220	3.018	2250	1861
.303 Savage	.311	180	3.761	1840	1445
.303 British	.311	215	3.149	1960	1608
7.65 mm. Mauser	.311	219	3.093	2000	1648
8 mm. Männlicher . . .	.317	227	3.099	2000	1648
.32–40 Black Powder . .	.319	165	4.317	1385	1033
.32–40 High Velocity . .	.319	165	4.317	2000	1523
.32 Winchester Special .	.3205	165	4.358	2000	1519
.33 Winchester	.336	200	3.951	2000	1560
.35 Winchester	.358	250	3.589	2150	1717
.38–55 Black Powder . .	.375	255	3.860	1321	1059
.38–55 H. V. Marlin . .	.375	255	3.860	1700	1322
.38–55 H. V. Winchester.	.375	255	3.860	1593	1240
.38–40 Black Powder . .	.400	180	6.222	1268	955
.38–40 H. V.	.400	180	6.222	1700	1146
.405 Winchester. . . .	.411	300	3.941	2204	1720
.44–40 Black Powder . .	.424	200	6.292	1245	943
.44–40 H. V.	.424	200	6.292	1500	1039
.45–70–405 Black Powder	.456	405	3.594	1275	1046
.45–70–300 H. V. . . .	.456	300	4.852	1825	1333
.45–90–300 Black Powder	.456	300	4.852	1480	1098
.45–90–300 H. V. . . .	.456	300	4.852	1925	1410
.50–110–300 Black Powder	.512	300	6.117	1536	1061
.50–110–300 H. V. . . .	.512	300	6.117	2150	1458
.50–100–450 Black Powder	.512	450	4.078	1383	1084

CERTAIN CARTRIDGES

pheric conditions, length of rifle-barrels, etc.)

Energy		Penetration of Bullet in ⅞-in. Pine Boards at 15 Feet		Trajectories of Bullets		
At Muzzle	At 150 yards	Soft-point	Lead	100-yard Trajectory. Height at 50 yards	200-yard Trajectory. Height at 100 yards	300-yard Trajectory. Height at 150 yards
foot-lbs.	foot-lbs.			inches	inches	inches
963	585	11	—	1.3	6.2	16.6
1040	632	11½	—	1.9	5.1	—
1963	1297	—	—	—	—	—
1239	747	12	—	1.4	6.4	16.9
1877	1285	13	—	1.2	5.5	13.6
2474	1689	—	—	—	—	—
1353	835	12	—	1.4	6.5	17.0
1834	1235	13	—	1.2	5.5	14.0
1945	1321	—	—	—	—	—
2017	1369	—	—	—	—	—
703	391	—	8½	2.7	11.3	28.3
1464	850	10	—	1.2	5.5	16.0
1464	846	12	—	1.2	6.0	16.4
1777	1081	13	—	1.2	5.8	15.5
2567	1637	15	—	1.0	4.7	12.2
988	635	—	9½	2.9	13.1	34.4
1635	990	14	—	—	7.9	—
1437	871	10	—	2.0	9.5	25.5
643	364	—	7½	3.2	14.4	35.7
1155	525	10	—	1.8	9.5	—
3237	1971	13	—	1.0	4.9	12.8
688	395	—	9	3.4	15.3	37.4
999	479	10	—	2.3	12.1	—
1460	984	—	15	2.6	11.7	29.0
2219	1184	13	—	1.5	7.4	—
1460	803	—	15	2.4	10.3	27.3
2470	1325	14	—	1.4	6.6	—
1572	973	—	12½	2.5	11.9	33.5
3080	1416	14	—	1.1	5.8	—
1912	1108	—	16	2.9	11.9	30.7

Rapidity of Fire

There are certain points in which a single-shot rifle is superior to a repeater. A larger proportion of its total weight is in the barrel, and this makes for greater accuracy, other things being equal. A single-shot rifle can have a Lyman or other aperture sight placed on the tang, and at the proper distance from the eye, whereas only those repeaters that have short bolts, or bolts that withdraw inside the action, will permit this. In general, it may be said that single-shot rifles permit the use of more accurate sights than repeaters do. They also are better adapted to set triggers, which are a decided advantage in deliberate offhand shooting, though not in firing at running game. They can be (but not all of them are) simpler and stronger in mechanism, and less liable to get out of order, than magazine rifles; though in this respect some of our bolt-action military and sporting rifles leave little to be desired.

A first-class marksman, who depends on making every shot count, will do more accurate shooting with a single-shot rifle, fitted with aperture rear and open wind-gauge front sights, and

double set triggers of "schuetzen" pattern, than he will with a repeating rifle. The very fact that he cannot "pump lead" will make him a more careful stalker and a deadlier marksman than he who relies on rapid fire. To those who do not hunt for count, but who take an honest pride in skilful woodcraft and clean kills at the first shot, the light-triggered and fine-sighted single-loader will ever remain the true artist's weapon. Theirs is the school of the nail driver — that good old school of the American backwoodsman, who tanned his boy's jacket for every miss, or of the South African Boer, who said to his son: "Here is a cartridge; go fetch me an antelope." I would there were no other school for riflemen to-day.

From the flint-lock to the percussion system, from muzzle-loaders to breech-loaders, from single-shots to repeaters, from magazines worked by hand to automatics or self-loaders, these are stages of mechanical progress, no doubt, and they are inevitable. The day in which the rifleman becomes a scatter-gunner, by raining lead from an automatic, has come, and with it true marksmanship declines. But we must bow to facts.

Repeating rifles are more convenient, in some

respects, than single-shots, and they are safer, to the extent that the chamber may be left empty, with the magazine filled and ready for instant use. They are good for stopping crippled game, and, once in a long while, to forestall the mauling of a hunter. Some of us have seen even a white-tail buck turn fiercely upon its assailant, and I can testify that it is not to be sneezed at. But I have often thought that, unless one is seeking undeniably dangerous game, he should give the animal that turns upon him a fairer fight than by riddling it with a repeater.

Lever-action magazine rifles are superior to bolt-actions in rapidity of aimed fire, and automatics, of course, outclass them both in this respect. While on this subject, I feel bound to condemn the use of automatic .22's on wild-fowl or other birds in flight. It does not seem as though one owner of such guns, out of ten, realizes or cares how far they will carry, and endanger human life, when they are fired at high angles. Nobody but the shooter is safe within half a mile of them.

As for automatic rifles for big game, sportsmanlike sentiment is against them. They tempt young hunters to rely more upon luck than upon

skill, and are likely to increase the number of paunch-shot or broken-legged cripples in proportion to the clean kills. On the other hand, when a cool and accurate marksman uses such a gun, he is tempted to kill immoderately. It may be true that "the gun does not make the butcher," but I submit that a fraction of a second is rather too brief an interval in which to trust an acquired sentiment to check a natural impulse. Let us give the sentiment of fair play a reasonable chance. It is all that distinguishes sport from slaughter.

Even from a cold-blooded technical standpoint, automatic rifles are open to serious criticism. They are necessarily more complicated than ordinary guns. An American hunter seldom takes with him more than one gun. If that weapon breaks down when he is in the depths of the wilderness, it leaves him in a sorry scrape. Moreover, the automatics are apt to have abominable trigger-pulls, and they are then not arms of precision, but scatter-guns of the worst class. Good shooting with a rifle depends more upon a delicate and positive control of the trigger than upon any other factor. In a recoil-operated mechanism the action of cocking is practically instantaneous, and is accompanied by a considerable jolt; conse-

quently the security of the sear against slipping must be beyond question. To make it so is easy enough, but to give it a smooth and easy release, as well, is another matter.

It is a much simpler problem to produce a satisfactory automatic shotgun than to make an automatic rifle that is safe to use with ammunition of high velocity and adequate killing power for big game, and simple and strong enough for wilderness hunting.

If a repeating rifle is chosen, it should be used primarily as a single-loader. Always aim as though your life depended upon that one shot. Van Dyke says, and says well: "The most important point is never to be in a hurry. Fire as you would at a target; that is, as coolly and deliberately. Never hasten a second because the game shows signs of starting, or because there is more than one deer or antelope waiting for your bullet. Place no dependence upon speed of fire."

Weight

While it is folly to add a single unnecessary ounce to a hunter's equipment, and especially to that part of it that he carries in his hands, yet a

rifle may be too light for good shooting. Even though the barrel be stiff enough, and the gun strong enough for hard service, yet it may kick so hard that it will cause the shooter to flinch. It is true that he will not think of recoil when aiming at game; but he will when shooting at marks, and he will fire ten shots at targets to one at large game — perhaps a hundred to one. It is by target shooting that he becomes familiar with his rifle. Unless he can "call his shots" with confidence (announce just where they struck before the result is signalled), when shooting at marks, he will have no confidence in himself or in his weapon when he takes to the field. No one can call his shots correctly if he flinches. Nothing short of "buck-ague" is so fatal to accuracy. The least shrink or blink at the instant of firing will send a bullet wide of the mark. Anything that induces flinching is a downright nuisance, and chief of such nuisances is a light rifle overcharged.

The recoil caused by different cartridges in rifles of the same weight may be compared by the muzzle energies that they develop. (See table.) For cartridges of 1000 to 1400 foot-pounds muzzle energy, the rifle should not weigh less than $7\frac{1}{2}$ pounds; for those of 1400 to 1800

foot-pounds, not less than $8\frac{1}{4}$ pounds; and for more powerful cartridges I would say not less than 9 pounds, unless the rifle is to be used as a saddle gun, or for some other special purpose.

Sights

Granting that one's rifle and ammunition are what they should be, the art of hitting the mark consists in true aim and a steady pull-off at the right moment. Good aim cannot be taken unless the rifle sights are clearly seen and aligned with precision.

The sights ordinarily fitted to American rifles at the factory leave much to be desired. The German silver front sight of "Rocky Mountain" pattern is badly shaped, too coarse, and it glitters in sunlight. The "buck-horn" rear sight with flaring wings hides a great part of the foreground and sometimes obscures the outline of the game itself. The combination is very liable to blur. I can see no good reason for such sights, other than the one once given me by Gemmer of St. Louis, successor of Samuel and Jacob Hawken, whose rifles were almost universally preferred by the Rocky Mountain trappers in the days of Jim

Bridger and Kit Carson. "It made no difference," he said, "what kind of sights we would put on a rifle; a mountain man would knock them off, anyway, and rig up something to suit himself." In this respect our riflemen have not changed much to this day. And there is good reason. Eyesight differs. Even when globe and peep sights are used, it often happens that when two men try to shoot with the same gun they cannot use the same elevation; the difference may amount to a full point at 200 yards.

It is hard to aim accurately with open sights. Modern rifle-barrels are short, the sights are not far apart, and the rear sight is near the eye. A man's eye cannot focus simultaneously on the two sights and on the target; one or other of them is sure to blur. Again, it is difficult always to catch the same amount of fore sight — to "draw the same bead," as riflemen say. When one is nervous, or overconfident, or is obliged to aim quickly, he is prone to draw too coarse a bead, and so he misses by overshooting. The varying play of light and shade on open sights is another source of error. An ivory bead is the best front sight for most men's eyes. It should be smoked with a match when hunting over

snow. Combination front sights of the Beach and Lyman patterns are far too frail for field use. Globe sights with hoods are only suitable for target shooting, as they do not let in light from above, and hence the pinhead is often invisible in the forest, or in any bad light. A Lyman open ivory bead with wind-gauge is a good sight, not that a wind-gauge is used in hunting, but because it is easy to adjust on the range, where the light bullets used in target practice are quite sensitive to wind.

If an open rear sight is used, it should be a plain bar, with only a small notch in the centre. Some riflemen use no notch at all, but it is better than a vertical line, for the latter blurs.

Personally I nearly always use a Lyman or Savage peep-sight with large aperture, preferably on the tang. Such a sight takes care of itself, the shooter paying no attention to it in aiming, but merely looking through it; his eye instinctively finds the centre, if the sight is as near as it should be. He does not draw fine or coarse, but merely centres the bead on the mark. This is a corrective of overshooting — that cardinal vice, so prevalent when an open rear sight is used hurriedly, or in bad light. With the rear

peep-sight there is nothing to attend to but the bead and the mark. All the foreground is in view. Elevation can be changed quickly and accurately. There is no blur. When such a sight is fitted on the tang it is a little in one's way sometimes; but this slight inconvenience is more than atoned for by the greater accuracy of aim. A peep-sight mounted in the rear sight slot, on the barrel, is good for nothing. One fitted to the rear of the receiver is good in clear light, but not so in dim light. To get the best out of a peep-sight it must stand within an inch or two of the eye. A Lyman sight can be fitted to the head of the firing-pin of such a bolt-action gun as the Remington-Lee, and cocking the piece brings the sight close to the eye.

A good telescope sight is the best of all sights for shooting at a considerable distance, but for shooting at running animals, or at large beasts near by, a tube sight is useless. A telescope tube attached to the barrel by such mountings as were formerly used is more of a hindrance than a help, being in the way of plain sights, and too delicate for rough service. The lenses are liable to get out of adjustment from the strains and blows to which a hunting rifle is exposed, and the tube may be

knocked out of alignment, in which case the hunter may not discover what is wrong until he has made some exasperating misses; then he has an hour's work to readjust the sight. A telescope tube, as ordinarily mounted on a rifle-barrel, is like a sore thumb, always in the way and frequently getting hurt. It catches in brush, bridle reins, and other obstacles, and is continually a source of anxiety. A tube mounted on the side of the barrel is an awkward thing to aim through, and it disturbs the balance of the gun.

A telescope sight made by Harry M. Pope of the Stevens Arms Co. can be removed from the gun in a few seconds, and remounted as quickly, with the certainty that it will return to its proper aligment without any adjusting. The tube slides forward when the gun recoils, so as not to strike the eye, and can be carried thus, offering no projection at the breech to catch in obstacles.

A recent invention, the Brayton tubeless telescope sight, deserves mention. It works on the principle of a Galileo telescope, having neither tube nor cross-hairs, but using the front and rear sights of the gun for alignment and elevation. It consists of a front and rear lens, so arranged that

they can be folded down when only the open sights are wanted, and turned up in a moment ready for service. They can readily be attached, or detached and carried in the pocket. The optical centre of the front lens is placed exactly at the top of the front sight. To the elevating part of the rear sight is attached one-half of a concave lens, divided horizontally. Thus the Brayton sights correspond to the upper half of a telescope placed immediately above the open rifle sights. In sighting, all objects below the lower edge of the lenses are seen without magnification, while what is seen through the upper half is magnified. The lenses add practically nothing to the weight of the rifle.

The advantage of a telescope sight does not consist so much in its magnifying power as in correcting aberrations of vision, eliminating blur and mirage, and enabling the shooter to see clearly a mark that is dim to the unaided eye. It corrects near-sightedness and far-sightedness, since the focus of the lenses can be adjusted for any eyes. It is also useful in identifying doubtful objects. The best power for field use is four diameters, which apparently brings the mark within one-fourth its actual distance from the shooter. Nothing is

gained by increasing the power, but much is lost, for it reduces the illumination, magnifies the tremor in aiming, and cuts down the field of view.

I think that the greatest improvement in rifles that we may expect in the near future is in devices for aiming them.

Trigger-Pull

Nearly all shooting at game is done offhand. Since no one can hold a rifle so steadily offhand that his sights are truly aligned upon a small mark for more than a very brief interval, perhaps a fraction of a second, a perfect command of the trigger is essential to good marksmanship. One must know the exact amount of finger pressure that will discharge the piece, and he must be capable of applying it with such nicety that the bullet will start at precisely the right instant. This is a difficult art to acquire. Anything that interferes with it is a serious handicap. If the trigger-pull is too stiff, or irregular, one cannot tell to a certainty when the gun will go off, and his attention is distracted from the proper business of aiming to the exasperating uncertainty of the

trigger. Military rifles are required to have a 6-pound, or at least 5-pound, trigger-pull, by which is meant that it takes such a weight, hung from the trigger, to release the hammer or firing-pin. This is entirely too hard for good offhand shooting, and the men who master it are exceptional. A 2-pound pull is enough for any one, and $1\frac{1}{2}$ pounds is not too light for a careful marksman. I am speaking now of single triggers.

The standard trigger-pull of American hunting rifles is 3 pounds. To ease it, do not tamper with the springs. Examine the notch into which the sear fits. It is toothed, so that, in order to release the hammer or firing-pin, it is necessary for the sear to do some lifting. Obviously if the notch were cut square instead of at an angle, and the tooth of the sear trimmed accordingly, the pull would be easier and the sear would slip out of the notch more smoothly. This should be done with a small oilstone, particular care being taken to grind squarely across, so that all of the notch and engaging parts of the sear bear evenly upon each other. Unless one is skilful in such work, he should give the job to a good gunsmith, telling him what trigger-pull he wants.

A creeping pull-off (one that starts, then sticks,

then goes off with a jerk), or a long drag (the distance through which a trigger moves before releasing the hammer or firing-pin), is an abomination.

Set triggers are only recommended for single-shot rifles.

Stock

Showy mountings, engraving, and other frills are out of place on a practical weapon. But there is one part of a rifle on which a little extra money may be spent to good advantage, and that is the stock — not on fancy wood, but on a hand-made stock specially fitted to the user, of such bend and length that it will "come up" like a well-fitting shot-gun stock, the sights coming properly to the eye at once, without any craning of the neck, and without bringing one's nose against his thumb, for that causes flinching. Choose straight-grained walnut, and see that the grain runs lengthwise of the grip, which is the weakest point. A half-pistol grip adds a little to the firmness with which the gun is normally held to the shoulder, but if it is so cut as to weaken the grip it should be discarded. A checked grip and forearm are aids to good hold-

ing. A shot-gun butt is better for a hunting rifle than the conventional crescent butt. The long prongs of a Swiss butt-plate are designed for nothing but offhand target shooting in the hip-rest position, and should never be used on a hunting rifle. Metal heel-plates are more serviceable than those of hard rubber.

There should be as little glitter about the rifle as possible, for it bothers the eye of the shooter and catches the eye of game. One has trouble enough in hunting without flashing signals to the animals hunted.

A sling for the rifle is a good thing. It relieves the strain on the arms in long tramps to and from the hunting grounds, and leaves the hands free to assist in climbing, parting brush, etc. The sling on the gun-cover is not enough, for the cover is left in camp.

Adjustment of the Rifle

When the rifle and its appurtenances have been procured, one should look for a level range of 300 yards or upward, upon which to test the rifle, adjust sights, and practise shooting at marks. It is folly for one to start off on a

hunting trip with a new rifle that has not been tested and its zero determined at measured distances.

In the vicinity of most cities there are rifle ranges, either military or civilian, where one can get permission to shoot. Failing this, seek a natural range backed by a steep bluff, or by water at least a mile wide, and facing in such direction that the sunlight will fall upon the targets. At 300 yards or more from the backstop build a rest from which to do your testing. A stout table will do, with a bag of sand upon which to rest the rifle-barrel, and a coat or other pad for the elbow. The rest must be solid and firm, for the least tremor will spoil the work. Its height should be such that when one sits close beside it on a stool, in a natural position for aiming, one's elbow will be at the right height when placed on the rest. The elbow must be rested, as well as the gun — this is important. The sandbag or pad on which the rifle rests should be built up to such a height that one does not crane one's neck in aiming, but sits erect, in an easy, natural attitude. Accurate work is to be done, and these details are essential; for accurate shooting from rest is not so simple

and easy as it looks. A soft rubber recoil pad may well be fitted to the rifle butt, for the recoil of a gun is felt much more when firing from rest and braced against it than when shooting off-hand. In shooting, rest the rifle about 6 inches back from the muzzle. First make sure that the sights are truly aligned so far as sidewise deviation is concerned. Shoot at a 4-inch bull's-eye 100 yards distant. If the gun shoots to the right, tap the front sight over to the right, and *vice versa.* Shifting the rear sight has the opposite effect. It is ridiculous how riflemen get mixed up about this simple matter. The rule is, Move the *front sight away from the direction in which you wish the bullet to go*, or move the *rear sight toward it.* If the front sight is correctly centred on the barrel, it should be let alone and adjustment made with the rear sight, for that looks better to the eye. Do this work when no wind is blowing.

Having aligned the rifle with precision, next find the exact elevation of rear sight for 100 yards, by firing and shifting sight until you get a group of at least five consecutive shots close together and close to the centre of the bull's-eye. In aiming, hold the front sight barely grazing

the lower edge of the bull's-eye ("at six o'clock," target shooters say, as though the bull's-eye were a clock dial). If, on the contrary, you were to aim with the top of the bead inside the bull's-eye, you could not be sure of always holding on the same spot, and your shots would straggle. Hold your breath while aiming, or slowly expire it, and, in the name of Davy Crockett, do not blink nor flinch the hundredth part of an inch when you draw trigger! A good corrective of flinching is to try to continue holding on the bull's-eye for a second or two after firing. Of course you cannot do it, but *try;* this helps to keep you steady at the critical moment of firing.

Make a memorandum of the 100-yard elevation. Shoot similarly at 200 yards, and at 300, using 8-inch and 12-inch bull's-eyes, respectively. Enter the elevations in your note-book, with memorandum of the ammunition used (the same, of course, that you expect to use in hunting), but do not score the elevations on your rear sight. Rest elevations and offhand elevations seldom tally exactly, particularly with heavy charges in guns of medium weight; and the sights should not be marked until the correct elevations for offhand shooting have been found and verified by

repeated practice, when you get so skilful that you can generally call your shot.

Adjusting for Zero

By the "zero" of a rifle I mean the minimum distance for which it should be sighted, and below which the rear sight should never be lowered. This depends upon the trajectory of the bullet and the kind of game hunted. I will assume that the rifleman wishes his gun sighted so that he can decapitate a squirrel or grouse at 50 to 100 feet, and yet get as wide a killing zone as the rifle is capable of when so aimed. By "killing zone" I mean the extreme distance throughout which a fatal shot can be delivered at a given animal without allowing for distance in aiming. Thus, for example, let us say that an 8-inch disk represents that part of a deer in which a bullet may be counted upon to inflict a mortal wound; then the deer's killing zone would be that distance throughout which the trajectory of the bullet would cut an 8-inch disk. For open country, where long shots are the rule, the rifle may then be sighted for an extreme rise of 4 inches above line of aim, and the killing zone

for deer will extend to that point where the descending bullet falls 4 inches below line of aim. Remember that line of aim or sight is different from line of fire (prolongation of axis of bore), and that it is in the shooter's favor, as will be seen below.

Assuming, for example, that the highest point of the trajectory above line of fire is 4½ inches, for a given rifle, when sighted to strike centre at 160 yards, and that this highest point is at 80 yards (it would really be a little nearer the target, but the difference is trifling at short range), also that the top of front sight stands one inch above axis of bore; then the trajectory would be about as follows:—

TRAJECTORY	DISTANCE IN YARDS							
	20	40	60	80	100	120	140	160
Above line of fire, *inches*	1.89	3.33	4.19	4.50	4.28	3.47	2.07	0
Sight allowance, *inches*	.87½	.75	.62½	.50	.37½	.25	.12½	0
Above line of aim, *inches*	1.02	2.58	3.46	4.00	3.90	3.22	1.94	0

This would be good for deer shooting up to about 200 yards, without change of aim.

But such a trajectory would be too high for shots near by. In the woods, where most shots

are fired at from 40 to 100 yards, a rise of $2\frac{1}{2}$ inches at 40 yards, and $3\frac{1}{2}$ inches at 60 yards, would be excessive. For hunting in a locality where there is plenty of cover, this rifle should be sighted to strike centre at about 80 yards; it will then shoot on a line practically level up to 100 yards.

A rifle giving the above trajectory should be sighted for a zero of 80 yards, and the rear sight fixed so that it cannot be lowered below that point. A notch should then be filed in the stem of the rear sight (if a Lyman) at the 160-yard elevation, deep enough to be found with the thumb nail, so that the hunter need not take his eyes from the game when he shifts elevation. If the rear sight is of open pattern, its steps should be filed for 80 and 160 yards. These two elevations are all that are needed for any shooting up to 200 yards. Elevations for longer ranges may then be marked, after determining them with care by a series of tests in varying weather, and averaging the results.

In the above manner, the proper zero for any rifle may be found by experiment.

Atmospheric conditions modify the trajectories of bullets, and so do differences of altitude. The

difference is quite noticeable when one takes to the Rockies a rifle tested at sea-level.

In shooting at a small mark very close by, as at the eye of an animal, or in trying to behead a snake, allowance must be made for the height of front sight above axis of bore, or one will shoot too low. Try the gun at a nail-head 10 or 15 feet away.

Target Practice

Men who do not live near good game regions, and who consequently can seldom try their rifles under actual field conditions, must do the next best thing — practice at targets. If such practice is carried out intelligently and persistently, it will go a long way toward making a man a good field shot. Clay birds do not fly like live wild birds; but no one will deny the value of trap shooting to city men whose hunting days are few and far between. It is the same with rifle practice at targets.

A beginner should first try his hand at shooting from a rest, until he can keep ten consecutive shots in a standard bull's-eye at the corresponding distance. I repeat that good shooting from rest is not so easy as it looks. Then he should try

offhand shooting at measured distances. The measuring should be done with accuracy. Guesswork is poor policy in anything connected with rifle shooting. Another poor policy is to cheat one's self, by omitting bad scores from the target register, or beginning a new score whenever a bad shot is made. It is the wild shots that should be studied; the good ones take care of themselves.

Start offhand practice at 25 yards, on a 1-inch bull's-eye, so that you can see the bullet holes without running back and forth. Take an easy, natural position, without straining any muscle, and not holding the gun as though you were afraid of it. Do not crane the neck forward, but hold the head almost erect, the right shoulder being thrown back so as to bring the rear sight (if mounted on the tang) within at least 2 inches of the eye. Stand with left side toward the target (unless you are left-handed), and rifle pointed well to the left. Hold the rifle with left arm free from the body. Body-rest and hip-rest are positions suitable only for prize shooting at targets. One can seldom use them in hunting; and, even when he can, previous exertion may have made the heart thump so

that supporting the elbow against the body would do more harm than good. Free-arm shooting is necessary for shots at moving objects, and one should get the knack of it at once, and stick to it.

If the rear sight is a Lyman, pay no attention to it in aiming; merely look through it and fix your eye primarily on the mark, secondarily on the bead of front sight. If open rear sight is used, bring its notch in alignment with the front sight, with the bead of latter standing just high enough so as not to blur. Aim at 6 o'clock, barely touching the lower edge of the bull's-eye, or with a very little white showing between it and the bead. Do not cant the rifle to one side, but hold it so that the sights are perpendicular. Canting affects the elevation. It makes no difference whether you keep both eyes open or close one of them; the two-eyes theory amounts to nothing in rifle shooting, save in snap-shooting at moving objects close by.

Draw a deep breath, and hold it; if your breath gives out before you are ready to shoot, stop, and try again. You will find that you cannot hold steadily on the bull's-eye. No one

AN UNEXPECTED MOMENT.

can.[1] The art consists in steadying down until the bead does its bobbing close around the bull's-eye, and in steadily drawing the trigger so that it lets go at the right instant. It is really not the tremor of the sight that gives the most trouble, but the lack of command of the trigger. We speak of "pulling" the trigger, but that is just what we must not do. The trigger must on no account be pulled or jerked, but *pressed* with the finger, gently and evenly. A novice is likely to keep his finger away from the trigger until he thinks he is ready to shoot, and then grope for it, only to pull it off with a jerk when he does touch it. That will never do. The finger must feel the trigger from the time that aim is first sought until the gun is discharged. This is the case even with set triggers, no matter how delicately they may be adjusted, although in using them the trigger finger is only slightly crooked, the additional pressure being sometimes given on the side of the trigger.

It is impossible to shoot well with a rifle unless

[1] In shooting from the position known as hip-rest, there comes a time, now and then, when a good marksman can hold immovably for several seconds. He is "frozen stiff." The trouble then is to work the trigger finger, for it is most likely "frozen" too.

one has such command of the trigger that he can press it off at exactly the right instant, without the slightest jerk, quiver, shrink, or blink of the eye. One's eye must be riveted on the mark and on the bead of front sight. There must be no nervous anticipation of explosion and recoil, no anxiety about the result until the shot has sped.

Many imagine that a man who is constitutionally nervous cannot become a good shot with the rifle. This is a delusion similar to the one about the "cold gray shooting eye." There is nothing in it. Temperament does not rule in marksmanship. Some of the best offhand rifle shots of our time are noticeably nervous men. Dr. W. G. Hudson, himself an expert marksman, says: "Much has been said about the ability to shoot well being due to 'strong nerves' — whatever that may mean. Riflemen often refer to an anticipated day's shooting by saying they are 'going to try their nerve.' According to my observation as a physician, however, nerve has little to do with it. I have had expert riflemen under my care suffering from pronounced neurasthenia, — the very word means weak nerves, — and they could, even during the height of their

disorder, shoot almost if not quite as well as when they were in good health. We really do not know exactly what physical element it is that is the chief factor in making one an expert rifleman, but I am inclined to think it is a certain education or development of coördination more than anything else."

Some men never become good shots, despite the most faithful practice. Some have a natural aptitude for it. But no one is born a marksman, in the sense that he can become expert without persistent and intelligent practice. Almost any one can become a pretty good shot, if he tries, and is not easily discouraged. Some must try harder than others.

The next step is target practice at unknown distances. For this purpose one should go to the woods or coast and shoot at natural objects, purposely choosing those that are not very distinct to the eye, because game seldom is, and the shooting should be at short ranges, at first. It is both wasteful and dangerous to use full-power hunting ammunition in this work. Reduced charges of powder, and lead bullets, loaded by the shooter himself, should be used. Some suggestions about reloading ammunition will be

given hereafter. Shooting at estimated distances, amid surroundings as nearly as possible like those of the hunting field, is of the greatest benefit to a beginner. He should first try his hand at stationary marks, and then at moving objects. It is of little benefit to shoot at marks tossed into the air by an assistant, because game does not behave that way. A keg rolled down a hill of moderate gradient but rough surface is a good mark. It should be tried both to the right and to the left, and from behind, at different angles.

Practice shooting uphill and downhill, and across ravines from one hill to another; also across water. Try shooting toward the sun, and at varying angles toward it and away from it. Practice in the dimness of dawn and twilight. In the winter, try shooting over the snow. Frequently choose large objects of uniform color, not very distinct from the background, and try to hit the centre.

This latter class of shooting at marks is of much more value to a hunter or soldier than shooting at regular targets at known distances, and it should be done in all kinds of weather, whenever one has an opportunity. Light charges

and lead bullets loaded by the sportsman himself are so cheap that he can indulge in plenty of practice; and it is practice that makes the marksman.

Never shoot at a mark unless you know that it, or something immediately back of it, will stop the bullet. Always handle a gun as though it were loaded; then the habit will become second nature. It is awkward to face a man's relatives after you have shot him.

Reloading Ammunition

When small-bore rifles using smokeless powder and mantled bullets were introduced, our riflemen immediately began to experiment with reloaded ammunition in them. The first efforts were abortive. Black gunpowder could not be used in such rifles, owing to excessive fouling in the quick twist. Shells that had been fired with service charges were rendered so brittle that they would split or crack off at the neck, and the necked part would sometimes be blown up into the rifling. Ordinary lead bullets would strip, or fuse at the base, and would lead the barrel. Cartridge manufacturers declared that

it was impracticable to reload the shells, and that it was unsafe for amateurs to experiment with smokeless powders in rifles. In so far as these warnings applied to reckless and unintelligent persons who merely "guessed at it," they were fully justified, as many a bulged or burst rifle proved.

But users of high-power rifles still insisted that they must have ammunition of moderate strength for target practice and small game shooting, so that they could learn to handle well the weapons that they would use in hunting big game. The regular factory-loaded ammunition was too expensive for ordinary shooting, too dangerous to use in settled districts, and its erosion of the barrel was so great as to limit its usefulness to actual field work. To meet this demand, ammunition makers brought out certain short-range cartridges charged with very light loads of smokeless powder and naked, unlubricated lead bullets. These, as might have been expected, were so weak and inaccurate as to be quite worthless. Then the amateurs tackled the problem in earnest. After many disappointments, they have at last succeeded in devising light and medium loads for high-power rifles that are cheap, accurate, and satisfactory all around.

Full instructions for loading such ammunition are given in the "Ideal Handbook" (Ideal Manufacturing Company, New Haven, Connecticut). I can also cordially recommend the book on "Modern Rifle Shooting from an American Standpoint," by Dr. W. G. Hudson (Laflin and Rand Powder Company, New York), for details as to the proper loading and handling of rifles.

In 1899 I designed for the .30 U.S.A. cartridge the bullet numbered 308206 in the "Ideal Handbook." Moulds were made in two sizes, casting bullets of 125 and 170 grains weight, respectively. The former was satisfactory up to 150 yards, but the latter did not give as good results at longer ranges as I had hoped for. Moulds casting bullets of this pattern are now furnished by the Ideal Manufacturing Company for all American high-power rifles and for several foreign arms. Recently Dr. Hudson has designed two bullets (Nos. 308256 and 308259) which give excellent results at 200 yards and upward. He was, I believe, the first who called attention to the fact that rifles supposedly alike vary considerably in actual caliber, and that if bullets used with smokeless powder did not entirely fill the rifling to the bottom of the

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grooves, the powder gas would leak past, causing unsteady flight. He also discovered that bullets cast of ordinary alloy were liable to fuse around the edges of the base from the heat generated by smokeless powder. His bullets of recent pattern, cast of an alloy consisting of 7 per cent tin, 7 per cent antimony, and 86 per cent lead, and properly lubricated, are excellent for target practice, riot service, etc., when used with such loads of smokeless powder as he recommends. Ammunition for the .30–40–220, thus reloaded by the rifleman himself, costs only $5.50 a thousand (or $3.15 a thousand if the metal is gathered up at the targets and remoulded), not counting the first cost of the shells, which are bought empty and are used over and over again.

Bottle-necked shells give more trouble in reloading than straight or tapered shells, being somewhat bothersome to resize, and they are weaker. Those which have been fired with service charge should not be reloaded, as they are brittle; but empty primed shells should be bought and these may be used scores of times with reduced charges. Decidedly the best all-round cartridges are those like the .32–40, which was

originally designed for black powder and lead bullets, and is used in rifles of slow twist. Rifles for this cartridge are now made with barrels of extra strength, which are safe and accurate both with black powder and with high power smokeless. The latter should not be used in old-fashioned .32–40 rifles, which have weak barrels.

Any intelligent person may be trusted to reload his own ammunition, provided he follows implicitly the instructions given by powder manufacturers and makers of reloading tools. But no one should experiment with different loads of smokeless powders, or with different brands, unless he has accurate scales with which to weigh the charges, nor unless he tests progressively, increasing his loads by only one grain at a time and watching the effect of increasing pressure on the primers.

Smokeless powders for small arms are of two distinct classes: —

1. Quick-burning, for shot-guns, pistols, and very light loads in rifles.

2. Slow-burning, for regular charges in rifles.

If a full charge of shot-gun smokeless is used in a rifle, it will burn too quickly, set up excessive pressure, and probably burst the gun. A charge

of shot is much more easily started in a gun-barrel than a solid bullet. The latter, if too suddenly started, has a tamping effect. Smokeless rifle powder burns slowly and progressively, if not tightly confined, gradually increasing its pressure until the bullet leaves the barrel. Its effect may be likened to that of a steadily increasing push, and that of shot-gun smokeless (behind a bullet) to a blow. The latter should never be used in rifles, save in minute charges, loose in the shell, for indoor practice with light bullets.

Smokeless powder should never be compressed in the shell, as black powder usually is. It requires an air space. If tightly packed behind the bullet, it develops a dangerous pressure. No wads, sawdust, or other filling should be used between powder and bullet, even though very light loads be used. If the powder and primer be of the right kinds, the ignition will be perfect when the powder is loose. The shell should be crimped on the bullet.

If a small heap of smokeless powder is ignited in the open, it does not explode like black gunpowder, but merely burns away. In order to explode, it must be confined. The rate of its explosion and the amount of pressure developed

depend very much upon how tightly it is confined and how much resistance is offered to the expansion of its gases. If packed tightly in the shell, or if loaded behind a heavier bullet than the charge is intended for, it may explode violently, like dynamite, and burst the barrel.

Riflemen should not draw hasty conclusions from the fact that high velocity ammunition is now supplied for certain old-fashioned rifles with ordinary soft steel barrels. I refer to the .38–40–180, .44–40–200, .45–70–300, .45–90–300, and .50–110–300 H. V. cartridges loaded to give initial velocities of from 1500 to 2150 feet. These have very light bullets in proportion to their calibers, and hence do not develop great pressures. The same powder charges behind heavy bullets would be decidedly unsafe in such guns.

Strong loads of smokeless powder should never be used behind unjacketed lead bullets. The latter may upset enough to have a tamping effect. They will at least melt at the base, and fly wild.

The mere thickness of a rifle barrel is no guarantee of its strength. I have seen the ponderous barrel of a 14-pound single-shot target rifle (.32–40) broken short off about 6 inches in front

of the breech, and the rear portion split lengthwise into two pieces, which were hurled in different directions, by a charge of quick-burning smokeless powder fired behind a common lead bullet. The breech action of the gun was blown to fragments, and the butt of the stock alone was left in the shooter's hand. Both he and the bystanders were seriously imperilled by this ignorant and foolhardy experiment. The eyesight of the man who fired the shot was saved by his thick glasses, which were ruined by flying particles of steel. He escaped with a burst eardrum and wounded hands.

Cast lead bullets should be at least $\frac{2}{1000}$ inch larger than the diameter between grooves of rifle-barrel, to prevent gas-cutting. The base of the bullet should be quite clean, as grease affects some smokeless powders quite seriously. The bullets should fit with uniform tightness in the shells; consequently the latter should be resized, first by swaging them down so that they will enter freely into the chamber, and then expanding the necks to their proper diameter, so that they will not injure the bases of the bullets, which invariably should be sharp and true.

A rifle-barrel that has been shot with full

power charge should be thoroughly cleaned before lead bullets are used in it, as some smokeless powders leave a tough, gummy residue in the barrel which makes lead adhere to it. Bullets patched with paper require that the rifle be cleaned after every shot, and they are nuisances.

Care of the Rifle

The residue left in the barrel by some smokeless powders causes the steel to rust, while that of others does not; but in all cases the barrel should be thoroughly cleaned after using, and not let stand dirty until the next day, for the products of primer combustion are extremely corrosive.

A gun that has been shot with smokeless powder is more troublesome to clean than one used with black gunpowder, because the residue is so sticky. Dr. Hudson recommends dipping a brass wire cleaning brush in a special nitro-cleaner, scrubbing it back and forth, from the breech, if possible, and allowing the brush to turn and follow the rifling; then letting the gun stand for a time, afterward thoroughly swabbing with a dry rag on the knob of the cleaning rod, and finishing with a rag wet in the solution. The

composition of this nitro-cleaner is Astral Oil (tested and found free from acid), 2 fluid oz.; Sperm Oil, 1 fl. oz.; Turpentine, 1 fl. oz.; Acetone, 1 fl. oz. Mix. It is a good rust preventive as well. Vaseline or cosmoline, or any animal oil that has a good body and is free from acid, is a good enough preventive of rust if the gun is frequently looked after; but if it is to be put away for a considerable time, or exposed to salt air, its bore should be swabbed with mercurial ointment.

Before going on a hunting trip, see that you have in your kit an extractor for broken shells and a copper plug that fits the bore of the gun between the lands, so that it will slip down the barrel rather easily. The latter is to drive out the neck of a shell that may have been blown too far up in the rifling for the other extractor to reach it. A brass rod for driving it is required. Extra parts of the breech mechanism that are liable to break should also be carried.

The Rifle in the Field

A novice's notion of the appearance of game is such as he gets from a visit to the Zoo, or from

a picture like Landseer's "Stag at Bay." When he looks for anything like this in the woods he will not see it. Let him study good photographs of wild birds on their nests, and note how the protective resemblance of their plumage makes them hard to catch with the eye. It is so with most animals, in cover. So long as a wild animal is motionless, it is difficult to distinguish from the brush and the grass and the tree trunks.

No matter how close a hunter may be to game, he should not shoot at the animal as a whole. He should pick out a particular spot, a small spot, a vital spot, and shoot for it with nail-driving aim. Otherwise he may miss a deer within brickbat range.

The best broadside mark is immediately behind the shoulder and only one-third of the way from the lower edge of the chest — in other words, the region of the heart. It is much better to hit a little farther forward than this, and thus smash the shoulder, than to hit farther back or higher; for either of the latter shots will probably result in a long chase.

If the game runs away after you have shot, look for blood on the ground and bushes where it stood, and along its trail. If you do not find

blood, or signs of staggering, give it up. You might as well chase after a rainbow.

Beware of overshooting when aiming downhill, because you then see more of the top of the animal than when you are on a level with it. Make no allowance for distance in either uphill or downhill shooting, unless the shot be an uncommonly long one. For what seem to be long shots downhill remember that, so far as trajectory is concerned, the only distance to be considered is that from the game to a point level with the animal and directly *under you.* In shooting uphill, regard only the *air-line* distance from yourself to the mark, and do not try to allow for any extra "lift" required by the high angle, or you will almost surely overdo it.

When shooting at running game, pick out an open space that the animal will cross, raise the rifle deliberately, and be sure that you see the sights as clearly as in target shooting. Then, and not till then, pay attention to the game also; aim for a particular spot in the open space that the animal will pass, and shoot just before it reaches that spot, the distance ahead depending upon the angle and speed of the beast's flight. Unless the ground is uncommonly open, this is

better than holding first on the game and then swinging the gun ahead, for you are at least sure of a clear space to shoot through.

This is all that can be told on paper. The rest — and it is indeed a great deal — must be learned by experience.

THE THEORY OF RIFLE-SHOOTING

By W. E. Carlin

THE THEORY OF RIFLE-SHOOTING

THERE is among shooters more or less of a feeling that theory is necessarily an ideal sort of a thing — of little practical value.

At any other stage of the world's history this would not seem strange; but at the dawn of the twentieth century, when scientific thought is about to rule the civilized world, and when on every hand we see our necessities, comforts, and luxuries supplied by scientific means, we can but feel that ignorance and prejudice are responsible for such a belief.

Science is organized thought. It has no emotions, hobbies, or bias. Its business is to investigate and discover reason for phenomena. Its one end is the establishment of the highest probability of truth.

It is extremely difficult for the human mind to free itself from conventional prejudice, and science has always had to struggle against this.

There was a time, at the dawn of scientific thought, when reasoning was deduced only from observed phenomena and experiment. These fragmentary laws were established, listed, and were gradually pieced together into a logical system, until the time came when science could reason both inductively and deductively, and could point out the road for practice to follow.

The inventor who designs and the mechanic who perfects a piece of mechanism could do nothing without the principle upon which to work. The great value lies in the established principle and not in the perfecting of it.

If everything were lost to us except the underlying principle, it would take but a few years to develop them again; while the principles themselves have taken untold ages to discover.

It is but a few years ago that arms, ammunition, etc., were designed by the mechanic. To-day all the great pieces are designed by experts. Every detail of the manufacture — the strains, recoil, range tables, velocities, etc. — are found upon paper before the making of the gun is begun.

Unfortunately for the layman the study of ballistics is an intricate one, requiring the use of the highest mathematics, but that does not prevent

one from gaining a little insight into the elements of the subject; and it is well to do so in order that he may not entertain certain false notions that are more or less prevalent among shooters.

In simplifying this subject, some accuracy is sacrificed. The methods are more or less empirical, and can be understood by any one who knows arithmetic. Those who wish to pursue the subject further are referred to the following list of books:—

Works referred to

The Bashforth Chronograph.
Text-book of Gunnery, 1887 (Royal Military Academy).
Problems in Direct Fire. Captain James M. Ingalls.
Hyde's Gunnery.
Proceedings of the Royal Artillery Institution; and Notes on Guns and Gunnery, by the Author.

In Vacuo

When a bullet emerges from a gun-barrel, it is acted upon by three forces — the propellent force of the powder gases, the resistance of the air, and the force of gravity. We will at first neglect the resistance of the air and consider the projectile as fired in a vacuum, acted upon only by the propellent force and the force of gravity.

Terrestrial gravitation, or the force of gravity, compels every unsupported body to fall immediately in a straight line toward the centre of the earth. It has been found from experiment that an object starting from rest will fall a distance of 16 ft. at the end of one second, and that at the end of the second second the body will fall through four spaces of 16 ft. or 64 ft., and so on. From this we learn that gravity is an accelerating force; also that the distance fallen will vary as the square of the time.

Gravity being a constant force at any one point on the earth's surface, it is therefore an uniformly accelerating force. Such a force is measured by twice the space fallen through in one second of time. This being 16 ft., the velocity of fall will be twice 16 ft., or 32 ft. per second. (The force varies from 32.5 ft.-sec. at the poles, to 32.1 ft.-sec. at the equator.)

As shown, the velocity of a falling body is 32 ft.-sec. at the end of the first second, 64 ft.-sec. at the end of the second second, and so on for any number of seconds or fractional parts of a second. In $\frac{1}{2}$ sec. the velocity would be $\frac{1}{2}$ of 32 ft.-sec., or 16 ft.-sec.; in $\frac{1}{4}$ second, $\frac{1}{4}$ of 32, or 8 ft.-sec., etc. So that to find the velocity of a falling body, mul-

tiply the time in seconds by the acceleration of gravity. This acceleration is represented by the letter g.

The space fallen through in each second is equal to the mean velocity for that second. Thus, a falling body starting from rest, or with a velocity of 0, would have a velocity of 32 ft.-sec. at the end of the first second; the mean velocity would be $\frac{1}{2}$ of $32+0=16$, so that the fall in the first second is 16 ft.

A body starts at the beginning of the second second with a velocity of 32 ft.-sec., and at the end of the second second the velocity is 64 ft.-sec. The mean velocity is therefore $\frac{1}{2}$ of $32+64=48$ ft., the space fallen through in second second, and so on.

The total distance fallen in the first and second seconds is therefore $16+48=64$ ft.

The following table will illustrate these relations.

Time in Seconds	Velocity at End of Each Second	Drop in Respective Seconds	Total Drop at End of Each Period
1	32 ft.-sec.	16 ft.	16 ft.
2	64 ft.-sec.	48 ft.	64 ft.
3	96 ft.-sec.	80 ft.	144 ft.

The simple formula, giving the total drop for any given time (from rest) is:—

$$H = \text{time}^2 \times \tfrac{1}{2} g;\ \text{usually}\ H = \tfrac{1}{2} g t^2;$$

in which

$H =$ total height fallen,
$t =$ time in seconds,
$g =$ acceleration of gravity.

Also, the fall in any given time, from rest or otherwise:—

$$H = \text{time} \times \text{mean velocity};$$
$$= \text{time} \frac{\text{initial vel.} \times \text{final vel.}}{2}.$$

The value of g has been roughly stated to be 32 ft. The value of g in New York is 32.1685 ft.; and $\frac{1}{2} g = 16.084$ ft., or 193 in. In $\frac{1}{100}$ of a second a bullet will drop (using the formula) $H = 193 \left[\frac{1}{100} \times \frac{1}{100}\right] = .0193$ in.

No matter how short the time, there must be some drop. The bullet begins to fall the instant it is free from the support of the gun-barrel. This will free one's mind at once of the idea that a bullet can travel a short distance in a straight line. "Flat" trajectory is an incorrect term; "low" trajectory is better.

The bullet starts under the influence of the

force of projection, and would move forward in a straight line unless it was affected by another force. The instant that the bullet passes from the gun muzzle and is free from support, it begins to drop toward the earth under the influence of gravity. The forward motion does not alter the drop; it simply carries the bullet over a certain space while it is falling. And as the drop is constantly increasing, the path or trajectory of the bullet is a curve.

Let *AC* represent the axis of the bore produced (this is an imaginary line from which the bullet is constantly dropping away), and suppose each of the equal spaces 1, 2, 3, etc., is traversed in a second of time. From what has been said, the bullet would have dropped at 1, 16 ft.; at 2, 16×4 ft., at 3, 16×9 ft. Drawing a line through these points thus found, we have the curve of the bullet.

In a vacuum all bodies fall equal distances in equal times. If a bullet were let drop from *C*, and another, fired with a higher velocity than our original bullet from *A*, both at the same instant, they would reach the plane *AB* together, although the bullet fired with the higher velocity would have traversed a greater horizontal range

during this time, and would consequently have a lower trajectory.

It is of no practical value to give examples of problems *in vacuo*, excepting the following simple method of finding the ordinates of the trajectory.

The ordinates of the trajectory are the heights of the bullet γ, γ'; above the horizontal plane AB

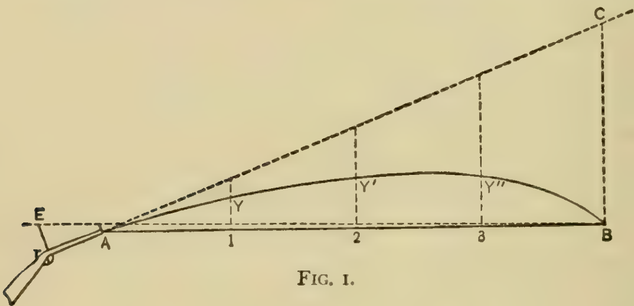


FIG. 1.

the angle of elevation is the angle made by the axis of the bore produced, AC, with the line AB. The line of sight makes a constantly diminishing angle with the horizontal plane AB, intersecting it at the point aimed at. (See EB, Fig. 1.)

To find the height of a bullet above the line AC at any point of the range, we have the following simple formula, deduced by Colonel Sladen, R.A., from the conditions *in vacuo*:—

$$y = \frac{gt}{2}(T - t), \text{ in which}$$

y = the vertical distance above the plane AC,
g = the acceleration of gravity, 32.16,
t = time of flight from muzzle to point at which ordinate y is to be found,
T = total time of flight over the whole range.

EXAMPLE

Given a bullet having a muzzle velocity of 1200 ft.-sec., the angle of elevation such that the bullet in its descent cuts the horizontal plane at a distance of 200 yd. from the muzzle. To find the height of the bullet above the plane AC at 50, 100, and 150 yd.

Find first the value of T, or total time of flight, as follows: Divide the range in feet by the muzzle velocity in foot-seconds, or $\frac{600}{1200} = \frac{1}{2}$ sec., total time of flight.

The time of flight at 50, 100, 150 yd. is found in the same manner.

Value of t at 50 yd. $= \frac{150}{1200} = .125$ sec.
Value of t at 100 yd. $= \frac{300}{1200} = .25$ sec.
Value of t at 150 yd. $= \frac{450}{1200} = .375$ sec.

Substituting these values in their proper places in the formula, we have, for 50 yd.: —

$$y = \frac{32.16 \times .125}{2}(.5 - .125) = .7537 \text{ ft.} = 9.04 \text{ in.},$$

which is the height of the bullet at 50 yd.

In the same manner, the height at 100 yd. is found to be 12.06 in.; and at 150 yd., 9.04 in.

As will be explained, this formula, slightly modified, gives fair results for the trajectories of high-velocity bullets in air.

The Resistance of the Air

The atmosphere which surrounds the earth is an elastic fluid, and the nearer the earth's surface the greater is its pressure, owing to the attraction of gravity and the superincumbent strata. The bullet in its flight must displace the air, and the resistance that it meets in so doing is far greater than one would at first suppose, while all the irregularities in the flight of a projectile are caused by the resistance of the air, as will be seen in the chapter on Drift.

Since much of the energy of the bullet is used to overcome this resistance, its velocity is being constantly reduced. We all know how difficult it is to walk against a wind of 60 mi. an hour, while wind of 100 mi. an hour (147 ft. per sec.) exercises a pressure of 50 lb. per square foot, and will uproot large trees. It is immaterial whether the wind blows against an object at rest or whether the object moves with the wind's velocity against still air.

It is little wonder, then, that rifle bullets, travelling at such great velocities as 1200 to 2000 ft.-sec.,

meet with tremendous resistance and lose their speed rapidly.

The following are examples of actual resistances experienced by ogival-headed projectiles of 1 in. and 4 in. diameters: —

VELOCITY	1-IN. PROJECTILE	4-IN. PROJECTILE
900 ft.-sec.	1.45 ft.-lbs.	23.3 ft.-lbs.
1200 ft.-sec.	5.84 ft.-lbs.	94. ft.-lbs.
1500 ft.-sec.	10.19 ft.-lbs.	163. ft.-lbs.
1700 ft.-sec.	12.80 ft.-lbs.	205. ft.-lbs.

A bullet therefore would drop much more in air than in a vacuum.

Suppose a certain .45 cal. bullet, having a muzzle velocity of 1300 ft.-sec., be shot *in vacuo* and in air, the relative drop is as follows: —

HORIZONTAL RANGE

	100 YD.	200 YD.	300 YD.
Drop in inches in a vacuum	10.2	41.1	92.4
Drop in inches in air	11.9	54.07	135.

It will be noticed how much the difference in drop increases at the longer ranges, and this would

be still more apparent in the case of a lighter bullet, which loses its velocity so much more rapidly. This difference in drop is due to the projectile having lost much of its velocity in the air, and has therefore taken longer to reach each range, and gravity has had a longer time in which to act.

The resistance encountered by a projectile depends upon its velocity, smoothness and shape of head, and the area it presents to the resistance of the air.

The area of surface depends upon the sectional area of the projectile and its steadiness in flight.

The resistance varies directly with the area. A projectile which has twice the area of another will experience twice the resistance.

In order to compare bullets, one with another, in their ability to overcome air resistance and sustain their velocities, we have the following relations: —

The area of a circle varies as the square of the diameter or δ^2; and as the horizontal section of a bullet is a circle, we may say that the resistance varies as δ^2.

The ability to overcome this resistance depends upon the weight of the bullet, written W; and in

order to make use of a convenient set of tables, these values are combined into a ballistic coefficient as follows:—

$$\frac{\delta^2}{w}; \text{ in which}$$

δ = the diameter of the projectile in inches
w = the weight of the bullet in pounds.

We have said that the resistance varies also greatly with the velocity. Unfortunately no integral exponent will represent this law; but Professor Bashforth found, as the result of his classic experiments, that the following laws were practically correct between their limits:—

For velocities greater than 1300 ft.-sec., the resistance varies as the square of the vel. or V^2.

For velocities between 1100 and 1300 ft.-sec., the resistance varies as the square of the vel. or V^3.

For velocities between 1000 and 1100 ft.-sec., the resistance varies as the square of the vel. or V^6.

For velocities between 820 and 1000 ft.-sec., the resistance varies as the square of the vel. or V^3.

For velocities less than 820 ft.-sec., the resistance varies as the square of the vel. or V^2.

It will be noticed that the sudden rise in resistance to the sixth power occurs about the velocity of sound. Although this fact was noted by Benjamin Robins in 1742, it was neglected by

subsequent experimenters, until Mr. Bashforth reaffirmed Robins's views and fixed a value to this sudden rise.

If we wish to express the resistance to a projectile moving at 1400 ft.-sec., we may write it $\delta^2 V^3$. Since the resistance is overcome by the weight of the projectile, and since the weight varies as the cube of the diameter, or δ^3, the retardation may be expressed by $\frac{\delta^2 V^3}{\delta^3}$. This is an interesting relation, for by examining the formula we see that an elongated is greatly superior to a round projectile, for the length and weight of the elongated may be altered at will without changing the diameter. A good weight and small diameter are necessary to preserve velocity. We also see that a large round shot has the advantage over a small one; for as we increase the diameter, the weight will increase more rapidly than the area.

All of us have, no doubt, seen it stated that small round shot are to be preferred, as they penetrate farther than large ones. As just explained, this is not the case! It makes no difference what the resistance be, whether from air or flesh, the result is the same.

The shape of head has considerable influence

on the resistance experienced. It has been found that when the resistance to a hemispherical head may be represented by 1 (unity), the resistance to the other forms of the same diameter are about as follows: —

1. When the resistance to a hemispherical head = 1,
2. The resistance to a hemispheroidal head = 0.78;
3. The resistance to an ogival head of 1 diam. = 0.78;
4. The resistance to an ogival head of 2 diam. = 0.83;
5. The resistance to a flat head = 1.53.

The resistance to projectiles in common use is about that shown by Nos. 2, 3, 4, etc.

The slope of the point seems not to be so important as the shoulder — where the head joins the body.

The density of air depends upon its nearness to the earth's surface, its temperature, and the moisture it contains. The warmer it is the lighter. The weights of aqueous vapor and air are to each other as 0.6235 : 1.0000. The tables which we will make use of are calculated for $66\frac{2}{3}$ per cent of moisture, but any difference may be neglected for our purposes.

As has been said, $\frac{\delta^2}{w}$ is called the ballistic coefficient.

EXAMPLE

Find the value of $\frac{\delta^2}{w}$ for a .45 bullet of 500 gr. Substituting the values in the formula, we have $\frac{.45 \times .45}{\frac{500}{7000}} = \frac{.2025}{\frac{500}{7000}}$. It is easier now to invert the denominator of this fraction and multiply by 7000, then divide this result by 500, $\frac{.2025 \times 7000}{500} =$ 2.835, which is the value of $\frac{\delta^2}{w}$. (The 7000 is introduced in the denominator to reduce grains to pounds.) By knowing the value of the ballistic coefficient we may make use of the tables to find the remaining velocities, times of flight, etc.

There are two tables for use with elongated bullets, and two for round shot.

The *Sv* table represents the relation between space or distance and velocity. The *Tv* table represents time and velocity. The difference table shows the difference in the tabular numbers. While the values are calculated for projectiles with ogival heads of 1½ diameters, they may be used for ordinary rifle bullets without any great error.

To use the *Sv* table, we have the relation

$$\frac{\delta^2}{w}s = SV - Sv;$$

in which *s* is the range in feet (always reduce yards to feet). *SV* is the tabular number repre-

senting the velocity at the beginning of the range. *Sv* is the tabular number representing the velocity at the end of the range.

Example

In what range will a .45 cal. bullet of 500 grs. be reduced in velocity from 1200 ft.-sec. to 1024 ft.-sec.? We must find s, and therefore transposing, our formula becomes,

$$s = \frac{SV - Sv}{\frac{\delta^2}{w}}; \quad \frac{\delta^2}{w} = 2.835.$$

Now, looking in the table we find the velocity 1200 ft.-sec., and on the same horizontal line under the heading *SV* we find the tabular number 40514.11, but we do not find any corresponding to 1024 ft.-sec. As the tables are abridged to intervals of 10 ft.-sec., we therefore select the nearest velocity that is less than 1024, and this is 1020 ft.-sec.; and the corresponding tabular number is 39,030.04. The corresponding number in the difference column is 125.74, which is for a difference of 10 ft.-sec., so that for 4 ft.-sec. we take .4 of 125.74, which is 50.29; this we add to

$$\begin{array}{r} 39030.04 \\ 50.29 \\ \hline 39080.33 \end{array} \quad \text{and we have}$$

which is the required *Sv* number for 1024 ft.-sec.

Now, subtracting the tabular numbers

$$\begin{array}{r} 40514.11 \\ 39080.33 \\ \hline 1433.78 \end{array}$$

we have 1433.78 diff.

And dividing this difference by

$$\frac{\delta^2}{w}, \quad \frac{1433.78}{2.835} = 505.7 \text{ ft.} = 168.5 \text{ yd.},$$

which is the required range.

The following examples illustrate the use to which the tables may be put: —

PROBLEM 1

Given the muzzle velocity and the value of $\frac{\delta^2}{w}$, to find the remaining velocity at any distance from the gun.

EXAMPLE I

The bullet from a new military rifle of .303 cal. weighs 215 gr. and has a muzzle velocity of 1900 ft.-sec. Find the velocity of the bullet at 200 and 500 yd. from the gun.

$$\frac{\delta^2}{w} = 2.989.$$

Transposing, the formula becomes

$$Sv = SV - \frac{\delta^2}{w}s.$$

From table, 1900 ft.-sec. =	43753.43
Multiplying $\frac{\delta^2}{w}$ by range in feet, 2.989 × 600 =	1703.40
Subtracting,	41960.03

which is the tabular Sv number.

Looking in the tables, we find the nearest number, less than 41960.03, to be 41945.77, which corresponds to 1470 ft.-sec.

Subtracting these numbers,	41960.03
	41945.77
we have	14.26

The tabular difference for intervals of 10 ft.-sec. is 46.10. To find how many foot-seconds the difference 14.26 represents, we multiply it by 10, which gives 142.6, and divide this number by 46.1, which gives 3 ft. per second. Adding this 3 ft.-sec. to 1470 ft.-sec. gives us 1473 ft.-sec., remaining velocity at 200 yd.

For 500 yd. (as before): —

1900 ft.-sec. =	43753.43		
2.989 × 1500 =	4483.50		
Subtracting,	39269.93		
Nearest tabular number,	39155.78 =	1030	ft.-sec.
Subtracting,	114.15 =	9.5	ft.-sec.
Remaining velocity at 500 yd. =		1039.5	ft.-sec.

Example II

In the field trials a .50-cal. double rifle by Jefferies, shooting 138 gr. powder and a bullet of 132 gr., gave a muzzle velocity of 1946 ft.-sec. What is remaining velocity at 200 yd. from the gun, $\frac{\delta^2}{w} = 5.116$?

The nearest velocity in the tables which is less than 1946 ft.-sec. is 1900 ft.-sec., and the corresponding tabular number is 43905.78

Adding .6 of the corresponding difference 37.66 = 22.59

which gives the tabular number for 1946 ft.-sec. = 43928.37

Now, as in Example I, 5.116 × 600 = 3069.60

Sv number = 40858.77

which corresponds to a remaining velocity of 1256.9 ft.-sec. at 200 yd.

Table II for round shot is used in the same manner as Table I.

Example

A .50-cal. round bullet, weighing 200 gr., has a muzzle velocity of 1900 ft.-sec. Find the remaining velocity at 200 yd.

$$\frac{\delta^2}{w} = 8.75.$$

$$\begin{aligned}
\text{Tabular number for 1900 ft.-sec.} &= 15869.98 \\
8.75 \times 600 &= 5250.00 \\
\text{Subtracting} &= 10619.98 \\
\text{Nearest tabular number} &= 10602.60 = 800 \text{ ft.-sec.} \\
\text{Difference} &= 17.38 = 1.3 \text{ ft.-sec.} \\
\text{Remaining velocity at 200 yd.} &= 801.3 \text{ ft.-sec.}
\end{aligned}$$

One will notice that the bullets in these examples started out with about the same *MV*, but the remaining velocities differ greatly owing to the difference in the relative value of their ballistic coefficients $\frac{\delta^2}{w}$. At longer ranges the difference is still more noticeable.

Tables I and II are calculated on the supposition that the thermometer stands at 60° F., and the barometer at 30 in., and that the atmosphere contains $66\frac{2}{3}$ per cent of saturation. The weight of a cubic foot of air will be, under these conditions, 534.22 gr. Any increase or decrease in these normal conditions may be allowed for by using Table III.

Example

Taking the data from Example II, suppose that the thermometer stood at 35° F. and the barometer 30.2 in.

Referring to Table III, we find the thermometer heading in first column under F. and on the same horizontal line under the head 30 (which is the barometer reading), the number 1.053, and in the difference column the number .035, which is the difference for $\frac{1}{10}°$; but as we have in this case $\frac{2}{10}°$, multiply .035 by $2 = .070$. This added to 1.053 gives 1.06, which is the new tabular number for the stated conditions.

The allowance for the increased density of the air is made by multiplying $\frac{\delta^2}{w}$ 5.116 by 1.06, which gives 5.422 for the new value of $\frac{\delta^2}{w}$.

Now, proceeding as in Example II, we have

$$
\begin{array}{rrl}
1946 \text{ ft.-sec.} = & 43928.37 & \\
5.422 \times 600 = & \underline{3253.20} & \\
 & 40675.17 & \\
 & \underline{40638.76} = & 1220 \text{ ft.-sec.} \\
 & 36.41 = & \underline{5.9} \text{ ft.-sec.} \\
 & & 1225.9 \text{ ft.-sec.}
\end{array}
$$

remaining velocity at 200 yd., at a loss of 31 ft.-sec. from the normal.

Should the air be lighter than normal, the tabular number will be less than unity, so that multiplying the value of $\frac{\delta^2}{w}$ by it, the value of $\frac{\delta^2}{w}$ will be diminished, and consequently there will be a gain in velocity over the normal.

Problem 2

Given the value of $\frac{\delta^2}{w}$ and the velocity at any range, to find the muzzle velocity.

Reversing Example II

Given, a bullet weight 342 gr., cal. .50 in., remaining velocity at 200 yd. 1256.9 ft.-sec. Find muzzle velocity.

$$\begin{array}{lrl}
Sv \text{ number for } 1250 \text{ ft.-sec.} & = & 40818.36 \\
\text{Difference for } 6.9 \text{ ft.-sec.} & = & \underline{40.04} \\
1256.9 \text{ ft.-sec.} & = & 40858.40 \\
5.116 \times 600 & = & \underline{3069.60} \\
 & & 43928.00 \\
\text{Nearest tabular number} & = & \underline{43905.78} = 1940 \text{ ft.-sec.} \\
\text{Difference} & & 22.22 = \underline{5.9+} \text{ ft.-sec.} \\
\therefore \text{ muzzle velocity} & & = 1945.9+ \text{ ft.-sec.}
\end{array}$$

When taking velocities of bullets and shot by means of a chronograph, it is customary to do so over short ranges, such as 100 ft. or 120 ft. In this case the velocity obtained is the mean velocity over the range, and this is assumed to be the actual velocity at mid range.

For example: —

A bullet of .45 cal., weighing 140 gr., has a mean velocity of 1200 ft.-sec. over a range of 100 ft. Find *MV*. Assuming 1200 ft.-sec. to be the actual velocity at 50 ft. and using Table II for spherical shot, we have

$$\begin{array}{lrl}
\dfrac{\delta^2}{w} = 10.125 \text{ (tabular number for) } 1200 \text{ ft.-sec.} & & \\
 & = & 13554.86 \\
10.125 \times 50 & = & \underline{506.25} \\
\text{Adding,} & & 14061.11 \\
\text{Nearest tabular number} & = & \underline{14022.11} = 1310 \text{ ft.-sec.} \\
\text{Difference} & & 39.00 = \underline{9.8} \text{ ft.-sec.} \\
\text{Required } MV & = & 1319.8 \text{ ft.-sec.}
\end{array}$$

PROBLEM 3

Given the value of $\frac{\delta^2}{w}$, the muzzle velocity, and the remaining velocity at any range, to find the time of flight.

EXAMPLE I

A .45-cal. bullet of 500 gr. has a muzzle velocity of 1310 ft.-sec. and a remaining velocity at 200 yd. of 1257 ft.-sec. Find the time of flight over the 200 yd. range.

We make use of the Tv table. The same relations hold good as for the Sv table, the formula being $\frac{\delta^2}{w}t = TV - Tv$, in which

t = time in seconds over the range,
TV = tabular number corresponding to MV,
Tv = tabular number corresponding to remaining velocity.

In this case we wish to find t, and the formula becomes

$$t = \frac{TV - Tv}{\frac{\delta^2}{w}};$$

Now $$\frac{\delta^2}{w} = 2.835$$

First find Tv number for 1257 ft.-sec.

The nearest velocity is 1250 ft.-sec., and its tabular number	=	154.5750
Adding .7 of the difference .0938	=	.0656
Tv number for 1257 ft.-sec.	=	154.6406
TV number for 1310 ft.-sec.	=	156.0970
Tv number for 1257 ft.-sec.	=	154.6406
Subtracting,	=	1.4564

Dividing this difference by $\frac{\delta^2}{w} = \frac{1.4564}{2.835} = .5137$ sec.-time of

flight. When making this last division, do not carry out the decimal places beyond the number used in the table, *i.e.* four; otherwise there will be a slight sacrifice in accuracy.

You will see at once that it is not necessary to know the remaining velocity. If the muzzle velocity is given, we can at once find the remaining velocities, and from them the time of flight.

Example II

The 32–40 cartridge has a muzzle velocity of 1470 ft.-sec. The bullet weighs 165 gr. Find the time of flight over a range of 200 yd.

$$\frac{\delta^2}{w} = 4.344.$$

	Sv		Tv
1470 ft.-sec. =	41945.77		156.6677
4.344 × 600 =	2606.40		
	39339.37	= remaining vel. 1045.9 =	154.5321
			2.1356

and 2.1356 ÷ 4.344 = .4916 sec., time of flight.

Problem 4

Given the range, the muzzle velocity, and the remaining velocity, to find the value of $\frac{\delta^2}{w}$.

The formula thus becomes $\frac{\delta^2}{w} = \frac{SVSv -}{s}$;

Example

In designing a rifle of .303 cal. it is required to have a muzzle velocity of 1900 ft.-sec., and a remaining velocity at 500 yd. of 1059.5 ft.-sec. What weight of bullet will fulfil

these conditions? We find first the value of $\frac{\delta^2}{w}$, as follows:

Tabular *Sv* number for 1900 ft.-sec.	= 43753.43
Tabular *Sv* number for 1039.5 ft.-sec.	= 39269.93
Subtracting,	4483.50

and dividing the difference by the range in feet

$$\frac{4483.50}{1500} = 2.989 = \text{value of } \frac{\delta^2}{w}.$$

Having found the value of $\frac{\delta^2}{w}$, we find the weight by dividing it by the square of the diameter, or $(.303 \times .303)$.

This division gives .030715 lb., which we reduce to grains by multiplying by 7000, and this in turn gives the weight of the bullet as 215 gr.

Problem 5

Given the muzzle velocity and the value of $\frac{\delta^2}{w}$, to find the drop of the bullet at any range. We proceed much as we did *in vacuo*, using the formula $H = \frac{1}{2} gt^2$. This formula gives a trifle greater drop than it should, for the bullet in falling meets a slight resistance; but the difference may be neglected, as it is very slight.

Empirical formulas have been put forward for the drop in air, but they are complicated, and for ordinary ranges they are not required.

Example

The muzzle velocity of the 45–90–300 cartridge is 1540 ft.-sec. To find the drop in inches at 200 yd.

$\frac{\delta^2}{w} = 4.728$. Finding the time of flight as before explained,

	Sv		Tv
1540 ft.-sec. =	42263.27		156.8787
$4.728 \times 600 =$	2836.80		
		Remaining vel.	
	39426.47 =	1054.2 ft.-sec. =	154.6238
			2.2549

$2.2549 \div 4.728 \quad = .4769$ sec., time of flight.
$.4769 \times .4769 \quad = .2274$, square of time.
$.2274 \times 193$ in. $= 43.88$ in. drop at 200 yd.

PROBLEM 6

To calculate the ordinates of a trajectory in air for small angles of elevation.

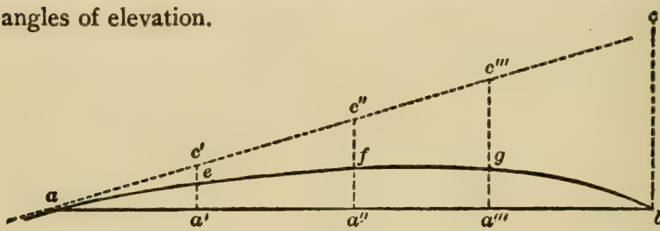


FIG. 2.

Suppose that in the above figure the height bc is 4 ft. and that the points a', a'', a''', divide the line ab into $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$ its length. Now, at one-half the distance ab, or at a'', the angle height $a''c''$ is one-half of 4 or 2 ft.; at a' the height $a'c'$ is one-quarter of 4, or 1; and so on for any other proportional part of the distance ab.

We may now suppose that the line ac is the axis of the bore produced of a rifle. The line ab is the horizontal plane or range. The points a', a'', a''', are points along this plane at which we wish to find the heights of the ordinates to the trajectory.

Suppose that the height *bc* represents the total drop of the bullet from the line *ac* at any range. Knowing the range or length of line *ab*, and the drop or height of line *bc*, we may construct a triangle as above, and from this drop or height *bc* find the proportionate heights at any other points along the line *ab*. Having established these heights at the desired points, we may find the drop of the bullet from the line *ac* at each of these points, and by subtracting this drop from the height (between the lines *ac* and *ab*), we shall have left the height of the bullet, at this point, above the line *ab*, or the ordinate to the trajectory above the horizontal plane *ab*.

Suppose, for instance, that the bullet has dropped from the line *ac*, a distance of $c'e$. If we subtract this distance $c'e$ from the whole height $a'c'$, we have the distance $a'e$, which is the height of the bullet above the horizontal plane at the point a'. Finding a series of these heights, we have the ordinates, or what we generally term the trajectory of the bullet.

Let us now apply all this to an actual case; first remarking, however, that (as will be seen in the chapter on Drift) steadiness of flight is merely relative; some projectiles are steadier than others and therefore meet with less resistance from the air. The bullet from the modern rifle is more accurate and steady than those from which the coefficients of resistance were deduced for the tables. So that it is customary to reduce the value of $\frac{\delta^2}{w}$ according to the factor of steadiness. If for the accurate modern bullet we multiply $\frac{\delta^2}{w}$ by .9, we shall closely approximate to this correction.[1]

[1] For the new small-bore projectiles the value of $\frac{\delta^2}{w}$ should be multiplied by 7. to .75.

In order to compare a calculated trajectory with one taken through screens, we will take that of the 45–70–500 cartridge as given in the *Forest and Stream* trajectory test.

Given, a bullet of .45 cal., weighing 500 gr., muzzle velocity 1310 ft.-sec. Find the height of bullet above the horizontal plane at 50, 100, and 150 yd. when shooting 200 yd.

Reducing $\frac{\delta^2}{w}$ by multiplying it by .9 gives 2.551 as its new value. The atmospheric conditions on the day the screen trajectory was made still further reduce it, and our new value for $\frac{\delta^2}{w} = 2.321$.

First find the total drop at 200 yd.

$$\begin{array}{rrlr}
 & Sv & & Tv \\
1310 \text{ ft.-sec.} = & 41154.54 & & 156.0970 \\
2.321 \times 600 = & \underline{1392.60} & \textit{Remaining vel.} & \\
 & 39761.94 = & 1092.3 \text{ ft.-sec.} = & \underline{154.9265} \\
 & & & 1.1705
\end{array}$$

$$\begin{array}{rcl}
1.1705 \div 2.321 & = & .5043 \text{ sec., time of flight.} \\
.5043 \times .5043 & = & .2543, \text{ square of time.} \\
.2543 \times 193 \text{ in.} & = & 49.07 \text{ in., drop at 200 yd.}
\end{array}$$

Now, dividing this drop proportionally at the required intermediate ranges as before described, and finding the drop of the bullet in the same manner as has just been shown, we have:

	50 YD.	100 YD.	150 YD.
Height of angle deducted from 49.07 in. at 200 yd.	12.26 in.	24.53 in.	36.80 in.
Drop of bullet	2.66 in.	11.15 in.	26.30 in.
Height of bullet above the horizontal plane	9.60 in.	13.38 in.	10.50 in.

	50 YD.	100 YD.	150 YD.
Heights found from screens were	9.40 in.	12.98 in.	9.95 in.
Calculated	9.60 in.	13.38 in.	10.50 in.
Difference	+.20 in.	+.40 in.	+.55 in.

The agreement between these two trajectories is very close. The trajectory of this cartridge at 100 yd. is

	25 YD.	50 YD.	75 YD.
Forest and Stream	2.32 in.	2.89 in.	2.45 in.
Calculated	2.14 in.	2.91 in.	2.25 in.
Difference	+.18 in.	−.02 in.	+.20 in.

The height of the bullet above the line of sight would be slightly less. The line of sight makes an angle with the horizontal line, which diminishes uniformly until the two lines intersect at the point aimed at.

Suppose in the gun just cited that the front sight was 1 in. above the axis of the bore using the 200 yd. heights.

	50 YD.	100 YD.	150 YD.
Height of bullet	9.60 in.	13.38 in.	10.50 in.
Height of sight angle	.75 in.	.50 in.	.25 in.
Height of bullet above line of sight	8.85 in.	12.88 in.	10.25 in.

TABLE I.—TIME AND VELOCITY

For Elongated Projectiles. Heads of 1½ Diameters' Radius

[Recalculated by Professor Greenhill from Mr. Bashforth's Data]

Velocity	Diff.	*Tv*	Diff.	*Sv*
Ft.-sec.				
100	15.6890	0.0000	1647.35	0.00
110	13.0823	15.6890	1504.46	1647.35
120	11.0703	28.7713	1383.78	3151.81
130	9.4919	39.8416	1281.40	4535.59
140	8.2272	49.3335	1192.94	5816.99
150	7.2013	57.5606	1116.21	7009.03
160	6.3531	64.7620	1048.26	8126.14
170	5.6474	71.1150	988.29	9174.40
180	5.0440	76.7624	934.99	10162.69
190	4.5485	81.8164	886.96	11097.68
200	4.1161	86.3649	843.81	11984.64
210	3.7419	90.4810	804.51	12828.45
220	3.4173	91.2230	768.90	13632.96
230	3.1323	97.6403	736.09	14401.86
240	2.8813	100.7726	705.92	15137.95
250	2.6603	103.6539	678.37	15843.87
260	2.4627	106.3142	652.61	16522.24
270	2.2875	108.7768	629.07	17174.85
280	2.1303	111.0644	607.08	17803.92
290	1.9884	113.1945	586.57	18411.00
300	1.8589	115.1828	566.97	18997.57
310	1.7426	117.0418	548.92	19564.54
320	1.6356	118.7844	531.58	20113.46
330	1.5375	120.4200	515.07	20645.04
340	1.4470	121.9575	499.20	21160.11
350	1.3638	123.4045	484.13	21659.31
360	1.2861	124.7682	469.42	22143.44

Velocity	Diff.	Tv	Diff.	Sv
Ft.-sec.				
370	1.2148	126.0543	455.55	22612.86
380	1.1476	127.2691	441.81	23068.41
390	1.0853	128.4167	428.71	23510.22
400	1.0268	129.5020	415.87	23938.03
410	0.9723	130.5289	403.50	24354.80
420	0.9226	131.5012	392.09	24758.30
430	0.8772	132.4237	381.57	25150.39
440	0.3550	133.3009	371.59	25531.96
450	0.7964	134.1359	362.37	25903.55
460	0.7610	134.9323	353.85	26265.92
470	0.7278	135.6933	345.72	26619.77
480	0.6973	136.4211	338.21	26965.49
490	0.6692	137.1185	331.27	27303.70
500	0.6433	137.7877	324.87	27634.97
510	0.6183	138.4310	318.45	27959.84
520	0.5952	139.0403	312.50	28278.29
530	0.5733	139.6446	306.74	28590.79
540	0.5526	140.2179	301.14	28897.53
550	0.5332	140.7705	295.94	29198.67
560	0.5148	141.3037	290.86	29494.61
570	0.4977	141.8185	286.15	29785.47
580	0.4821	142.3162	282.05	30071.62
590	0.4677	142.7983	278.32	30353.67
600	0.4539	143.2660	274.58	30631.99
610	0.4400	143.7199	270.62	30906.57
620	0.4271	144.1599	266.95	31177.19
630	0.4142	144.5870	262.99	31444.14
640	0.4020	145.0012	259.30	31707.13
650	0.3902	145.4032	255.58	31966.43
660	0.3787	145.7034	251.81	32222.01
670	0.3678	146.1720	248.28	32473.82
680	0.3576	146.5399	244.96	32722.10
690	0.3480	146.8975	241.86	32967.06

Velocity	Diff.	*Tv*	Diff.	*Sv*
Ft.-sec.				
700	0.3385	147.2455	238.67	33208.92
710	0.3292	147.5840	235.39	33447.59
720	0.3196	147.9132	23.173	33682.98
730	0.3105	148.2328	228.25	33914.71
740	0.3019	148.5434	224.93	34142.96
750	0.2938	148.8453	221.78	34367.89
760	0.2823	149.1391	218.23	34589.67
770	0.2765	149.4243	214.28	34807.90
780	0.2681	149.7008	210.48	35022.18
790	0.2602	149.9689	206.83	35232.66
800	0.2526	150.2291	203.31	35439.49
810	0.2450	150.4817	199.67	35642.80
820	0.2371	150.7266	195.64	35842.47
830	0.2290	150.9638	191.23	36038.11
840	0.2210	151.1928	186.73	36229.34
850	0.2133	151.4138	182.39	36416.07
860	0.2060	151.6271	178.20	36598.46
870	0.1990	151.8331	174.15	36776.66
880	0.1924	152.0322	170.24	36950.81
890	0.1860	152.2245	166.43	37121.05
900	0.1799	152.4105	162.80	37287.48
910	0.1741	152.5904	159.26	37450.28
920	0.1685	152.7644	155.83	37609.54
930	0.1631	152.9329	152.52	37765.37
940	0.1580	153.0960	149.31	37917.89
950	0.1531	153.2540	146.20	38067.20
960	0.1484	153.4071	143.18	38213.40
970	0.1439	153.5555	140.26	38350.58
980	0.1395	153.6993	137.43	38496.84
990	0.1354	153.8388	134.68	38634.27
1000	0.1314	153.9742	132.01	38768.95
1010	0.1272	154.1055	129.08	38900.96
1020	0 1227	154.2327	125.74	39030.04

Velocity	Diff.	Tv	Diff.	Sv
Ft.-sec.				
1030	0.1150	154.3554	119.07	39155.78
1040	0.1046	154.4704	109.28	39274.85
1050	0.0938	154.5750	98.95	39384.13
1060	0.0857	154.6688	91.27	39483.08
1070	0.0800	154.7545	86.02	39574.35
1080	0.0755	154.8345	81.91	39660.37
1090	0.0710	154.9100	78.75	39742.28
1100	0.0688	154.9819	75.97	39821.03
1110	0.0663	155.0507	73.93	39897.00
1120	0.0641	155.1170	72.16	39970.93
1130	0.0624	155.1811	70.83	40043.09
1140	0.0608	155.2435	69.60	40113.92
1150	0.0592	155.3043	68.40	40183.52
1160	0.0577	155.3635	67.23	40251.92
1170	0.0562	155.4212	66.00	40319.15
1180	0.0548	155.4775	64.98	40385.24
1190	0.0535	155.5323	63.89	40450.22
1200	0.0522	155.5858	62.84	40514.11
1210	0.0500	155.6379	61.81	40576.95
1220	0.0496	155.6888	60.80	40638.76
1230	0.0485	155.7384	59.88	40699.56
1240	0.0473	155.7869	58.92	40759.44
1250	0.0462	155.8342	58.04	40818.36
1260	0.0452	155.8805	57.17	40896.40
1270	0.0442	155.9257	56.38	40933.57
1280	0.0433	155.9699	55.61	40989.95
1290	0.0424	156.0132	54.86	41045.56
1300	0.0415	156.0555	54.12	41100.42
1310	0.0406	156.0970	53.45	41154.54
1320	0.0398	156.1377	52.79	41207.99
1330	0.0391	156.1775	52.15	41260.78
1340	0.0383	156.2165	51.52	41312.93
1350	0.0376	156.2548	50.95	41364.45

Velocity	Diff.	*Tv*	Diff.	*Sv*
Ft.-sec.				
1360	0.0369	156.2924	50.39	41415.40
1370	0.0363	156.3294	49.90	41465.79
1380	0.0357	156.3656	49.41	41515.69
1390	0.0351	156.4013	48.94	41565.10
1400	0.0345	156.4364	48.52	41614.04
1410	0.0340	156.4709	48.12	41662.56
1420	0.0335	156.5049	47.72	41710.68
1430	0.0330	156.5384	47.53	41758.40
1440	0.0325	156.5714	47.00	41805.73
1450	0.0321	156.6039	46.68	41852.73
1460	0.0317	156.6360	46.36	41899.41
1470	0.0313	156.6677	46.10	41945.77
1480	0.0309	156.6989	45.80	41991.87
1490	0.0305	156.7298	45.52	42037.67
1500	0.0301	156.7602	45.28	42083.19
1510	0.0298	156.7903	45.10	42128.47
1520	0.0295	156.8201	44.93	42173.57
1530	0.0292	156.8496	44.77	42218.50
1540	0.0289	156.8787	44.57	42263.27
1550	0.0285	156.9076	44.37	42307.84
1560	0.0282	156.9361	44.19	42352.21
1570	0.0279	156.9643	44.01	42396.40
1580	0.0277	156.9923	43.84	42440.41
1590	0.0274	157.0199	43.68	42484.25
1600	0.0271	157.0473	43.47	42527.93
1610	0.0268	157.0744	43.27	42571.40
1620	0.0265	157.1012	43.08	42614.67
1630	0.0262	157.1277	42.90	42657.75
1640	0.0260	157.1539	42.72	42700.65
1650	0.0257	157.1799	42.55	42743.37
1660	0.0255	157.2056	42.39	42785.92
1670	0.0252	157.2311	42.18	42828.31
1680	0.0249	157.2563	41.98	42870.49

VELOCITY	DIFF.	*Tv*	DIFF.	*Sv*
Ft.-sec.				
1690	0.0247	157.2812	41.78	42912.47
1700	0.0244	157.3302	41.60	42954.25
1710	0.0242	157.3302	41.41	42995.85
1720	0.0239	157.3544	41.23	43037.20
1730	0.0237	157.3783	41.06	43078.49
1740	0.0234	157.4019	40.90	43119.55
1750	0.0232	157.4254	40.69	43160.45
1760	0.0230	157.4486	40.53	43201.14
1770	0.0227	157.4715	40.33	43241.67
1780	0.0225	157.4942	40.19	43282.00
1790	0.0223	157.5168	40.00	43322.19
1800	0.0221	157.5390	39.81	43362.19
1810	0.0219	157.5611	39.68	43402.00
1820	0.0217	157.5830	39.51	43441.68
1830	0.0214	157.6046	39.34	43481.19
1840	0.0212	157.6260	39.17	43520.53
1850	0.0210	157.6473	39.01	43550.70
1860	0.0209	157.6683	38.90	43598.71
1870	0.0207	157.6892	38.75	43637.61
1880	0.0205	157.7098	38.61	43676.36
1890	0.0203	157.7303	38.46	43714.97
1900	0.0201	157.7506	38.32	43753.43
1910	0.0199	157.7707	38.19	43791.75
1920	0.0197	157.7907	38.01	43829.94
1930	0.0196	157.8104	38.83	43867.65
1940	0.0194	157.8493	37.48	43943.44
1950	0.0192	157.8493	37.48	43943.44
1960	0.0190	157.8685	37.26	43980.92
1970	0.0187	157.8875	36.99	44018.18
1980	0.0185	157.9062	36.73	44055.17
1990	0.0183	157.9247	36.47	44091.00
2000	0.0181	157.9430	36.21	44128.37
2010	0.0178	157.9610	35.95	44164.58

Velocity	Diff.	*Tv*	Diff.	*Sv*
Ft.-sec.				
2020	0.0176	157.9789	35.65	44200.53
2030	0.0174	157.9965	35.35	44236.18
2040	0.0171	158.0138	35.06	44271.53
2050	0.0169	158.0310	34.77	44306.50
2060	0.0167	158.0479	34.49	44341.36
2070	0.0165	158.0646	34.21	44375.85
2080	0.0163	158.0811	33.93	44410.06
2090	0.0160	158.0974	33.60	44443.90
2100	0.0158	158.1134	33.34	44477.50
2110	0.0156	158.1292	33.02	44510.93
2120	0.0154	158.1448	32.76	44543.95
2130	0.0152	158.1603	32.50	44576.71
2140	0.0150	158.1755	32.25	44609.21
2150	0.0149	158.1905	32.00	44641.46
2160	0.0147	158.2054	31.75	44673.46
2170	0.0145	158.2200	31.46	44705.21
2180	0.0143	158.2345	31.22	44736.67
2190	0.0141	158.2488	30.98	44767.89
2200	0.0139	158.2629	30.74	44798.87
2210	0.0138	158.2768	30.51	44829.61
2220	0.0136	158.2906	30.23	44860.12
2230	0.0134	158.3042	30.01	44890.35
2240	0.0133	158.3176	29.79	44920.36
2250	0.0131	158.3309	29.53	44950.15
2260	0.0130	158.3440	29.31	44979.68
2270	0.0128	158.3569	29.14	45008.99
2280	0.0127	158.3697	28.98	45038.13
2290	0.0120	158.3824	28.00	45067.11
2300	0.0125	158.3950	28.82	45096.01
2310	0.0125	158.4075	28.84	45124.83
2320	0.0124	158.4200	28.85	45153.67
2330	0.0124	158.4324	28.88	45182.52
2340	0.0123	158.4447	28.91	45211.40

Velocity	Diff.	*Tv*	Diff.	*Sv*
Ft.-sec.				
2350	0.0123	158.4571	28.94	45240.31
2360	0.0123	158.4694	28.98	45269.25
2370	0.0122	158.4816	29.02	45298.23
2380	0.0122	158.4938	29.06	45327.25
2390	0.0122	158.5060	29.10	45356.31
2400	0.0121	158.5182	29.16	45385.11
2410	0.0121	158.5303	29.21	45414.57
2420	0.0121	158.5424	29.27	45443.78
2430	0.0121	158.5545	29.33	45473.05
2440	0.0120	158.5665	29.35	45502.38
2450	0.0120	158.5785	29.37	45531.73
2460	0.0119	158.5905	29.39	45561.10
2470	0.0119	158.6024	29.41	45590.49
2480	0.0119	158.6143	29.44	45619.90
2490	0.0118	158.6261	29.42	45649.34
2500	0.0117	158.6379	29.40	45678.76
2510	0.0117	158.6406	29.39	45708.16
2520	0.0116	158.6613	29.32	45737.55
2530	0.0115	158.6729	29.25	45766.87
2540	0.0115	158.6845	29.13	45796.12
2550	0.0114	158.6959	29.01	45825.25
2560	0.0112	158.7073	28.84	45854.26
2570	0.0111	158.7185	28.67	45883.10
2580	0.0110	158.7207	28.50	45911.77
2590	0.0109	158.7407	28.29	45940.27
2600	0.0108	158.7516	28.12	45968.58
2610	0.0107	158.7624	27.91	45996.68
2620	0.0106	158.7731	27.70	46024.50
2630	0.0105	158.7837	27.54	46052.29
2640	0.0103	158.7942	27.33	46079.83
2650	0.0102	158.8045	27.18	46107.16
2660	0.0101	158.8147	26.97	46134.34
2670	0.0100	158.8248	26.77	46161.31

VELOCITY	DIFF.	*Tv*	DIFF.	*Sv*
Ft.-sec.				
2680	0.0099	158.8348	26.62	46188.08
2690	0.0098	158.8447	26.43	46214.70
2700	0.0097	158.8545	26.23	46241.13
2710	0.0096	158.8642	26.09	46267.36
2720	0.0095	158.8738	25.90	46293.45
2730	0.0094	158.8833	25.71	46319.35
2740	0.0093	158.8927	25.52	46345.66
2750	0.0092	158.9020	25.34	46370.58
2760	0.0091	158.9112	25.15	46395.02
2770	0.0090	158.9203	24.97	46421.67
2780	0.0089	158.9293	24.79	46446.04
2790	0.0088	158.9382	24.62	46470.83
2800	0.0087	158.9470	24.32	46495.45

TABLE II

For Spherical Projectiles

VELOCITY	DIFF.	*Tv*	DIFF.	*Sv*
Ft.-sec.				
300	1.2232	0.0000	366.91	0.00
310	1.1505	1.2232	356.67	366.91
320	1.0824	2.3737	346.37	723.58
330	1.0217	3.4561	337.22	1069.95
340	0.9647	4.4778	328.01	1407.17
350	0.9137	5.4425	319.78	1735.18
360	0.8553	6.3562	311.51	2054.96
370	0.8218	7.2215	304.07	2366.47
380	0.7805	8.0433	296.60	2670.54
390	0.7432	8.8238	289.84	2967.14

Energy

Since any moving object requires force to stop it, it is capable of doing a certain amount of work. This mechanical work is called "energy," and for light projectiles is expressed in foot-pounds; the unit being the force required to lift a one-pound weight one foot from the ground.

Energy varies as the weight. If two bullets travel at the same velocity, but one weighs twice as much as the other, the heavier will have twice the energy of the other.

If the velocity of one be doubled, however, the energy will be much more than doubled; for as a factor in the formula, the energy varies as V^2.

The formula for finding the energy of a bullet is

$$E = \frac{WV^2}{2g}; \text{ in which}$$

E = the energy in foot-pounds,
W = weight of shot in pounds,
V = velocity of shot in foot-seconds,
G = acceleration of gravity, 32.16.

If a one-pound shot be projected directly upward with a muzzle velocity of 1000 ft.-sec., it will have a muzzle energy of

$$\frac{1 \times 1000 \times 1000}{2 \times 32.16} = 15.547 \text{ ft.-lb.}$$

If shot in a vacuum, this shot would rise to a height of 15,547 feet. If it was fired in air, the same amount of force would be required to bring it to a state of rest, but it would not rise to anything like this height, owing to the resistance of the air, which causes such a diminution in the velocity, and consequently energy.

Example I

Given, a .50-cal. bullet of 342 gr., having a muzzle velocity of 1946 ft.-sec. Find the muzzle energy and the energy at 200 yd. from the gun.

(The 7000 is introduced to reduce grains to pounds.)

Then finding the velocity at 200 yd. to be (taking the nearest whole number) 1257 ft.-sec.,

$$\text{Energy at 200 yd.} = \frac{342 \times 1257 \times 1257}{7000 \times 2 \times 32.16} = 1209 \text{ ft.-lb.}$$

We see that half the total energy is already lost, in the short range of 200 yd., because the energy varies as V^2, and how important it is that a hunting and military bullet should have a low ballistic coefficient in order that its energy should be sustained.

Working backward from the last example, it is required that a 342-gr. bullet of .50 cal. have a muzzle energy of 2876 ft.-lbs. What is the required muzzle velocity to fulfil this condition?

We have first to find V^2.

$$V^2 = \frac{2876 \times 7000 \times 2 \times 32.16}{342} = 3{,}786{,}228;$$

and extracting the square root of this number, we get 1945+ ft.-sec. as the muzzle velocity required.

The velocity necessary to produce a given energy can be found at any range, in the same manner.

Example II

Given, a muzzle velocity of 1946 ft.-sec., and a muzzle energy of 2876 ft.-lbs.; required, the weight of bullet to fulfil these conditions. Here

$$W = \frac{2876 \times 7000 \times 2 \times 32.16}{1946 \times 1946} = 341.9 \text{ gr.}$$

Penetration

At first sight it would seem that penetration was synonymous with velocity, and that the higher the velocity, the deeper the penetration. This, however, is not necessarily the case.

The greatest effect, in the sense of energy, or stored-up work, is of course near the gun muzzle or when the velocity is highest; but it sometimes happens that high velocity militates against the penetration of soft lead bullets and those that are easily deformed. The tendency of soft lead and hollow-pointed bullets is to deform or mushroom almost immediately upon impact. The higher the velocity, the greater is this deformation, which increases the diameter of, and consequently the

resistance to, the bullet, so that its penetration is greatly lessened. When this was first noted — years ago — it gave rise to the absurd notion that a bullet must gain in speed after leaving the gun-barrel, otherwise how account for the fact that sometimes the penetration was greater at a distance from the gun than at the muzzle? It was, however, shown that light, hollow-pointed express bullets often deformed so much at high velocities that they did not penetrate so far as when the velocity was lower. If the projectiles are hardened with tin, so that they fairly retain their shape, velocity will increase their penetration.

Some further remarks on this matter will be found in "The Hunting Rifle."

Drift

"Drift" is the term applied to any deviation from the original direction of a projectile, except that caused by the force of gravity.

Drift is caused by the unequal pressure of the air upon the surface of a more or less imperfect projectile, and from it arise all the inaccuracies and irregularities of flight of a projectile.

I shall treat this subject somewhat at length, as many fanciful notions about it still exist.

We will first take up the case of the spherical bullet, showing why an accidental motion of rotation is acquired in a smooth-bore barrel, and why a rotating bullet must drift in the direction in which its front or anterior hemisphere is rotating.

The centre of form of a spherical projectile is the exact centre of the sphere.

The centre of weight or gravity coincides with the centre of form, only, when the projectile is perfectly homogeneous and true in form; and this is never the case in practice, the centre of gravity always lying more or less apart from the centre of form.

We know that a number of equal parallel forces is equivalent to a single force, representing the aggregate of the several forces, and called the resultant. The resultant acts through the centre of gravity of the body.

By the term "motion of translation" is meant the forward motion given the bullet by the powder gases.

If we suppose the case of a perfect spherical projectile, in which the centres of gravity and form coincide, shot from a perfectly true cylindrical barrel, the axis of the bore passing through

the centres of form and gravity of the ball, and, finally, the bullet meeting with equal resistance on all its parts which are in contact with the barrel when passing down it, there would be no motion of rotation acquired.

The powder gases are represented as a number of equal parallel forces acting on the posterior hemisphere; the sum of these separate forces is equivalent to the resultant acting along the line *gP*, through the centres of form and gravity and along the axis of the bore. There is, under these assumptions, no reason why the bullet should acquire a motion of rotation. But suppose that we consider it as in actual practice. Let us suppose that the centre of gravity is situated below the centre of form, both being in the same vertical plane as the axis of the bore.

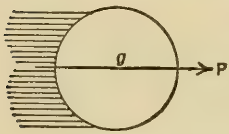


Fig. 3.

Here we no longer have a single force acting along the axis of the bore and through the centres of form and gravity of the ball. The resultant acts along the axis of the bore and the line *cP* through the centre of form,

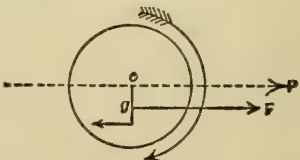


Fig. 4.

but in producing a motion of translation to the projectile it is equivalent to the same force P acting through the centre of gravity and along the line gF. A couple is thus formed whose force is P and length of arm gc. The effect of this couple is to produce a motion of rotation of the projectile about a horizontal axis passing through g, the powder gases acting on a larger surface above the centre of gravity than below it, and the lighter side rotating toward the heavier side. In this case the projectile rotates from above downward.

Should the centre of gravity be situated, above, to the right, or to the left of the centre of form, the motion of rotation will be upward, to the right, or to the left, as the case may be.

These acquired motions of rotation are accidental, inasmuch as one does not know the rela-

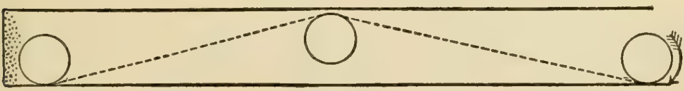


FIG. 5.

tive positions of the centres of form and gravity when the ball is in the gun.

Should the bullet not fit the barrel perfectly, there will be "gas cutting" and unequal friction,

from contact with only one side of the barrel. It is little wonder that round bullets from smooth-bore barrels give wild shooting except at very short ranges. The accuracy may be somewhat improved if the bullet fits very tight.

Now, in practice and theory, it is found that the ball will always deviate in the direction in which the anterior hemisphere is rotating. The reason for this is as follows:—

Now suppose that Figure 6, the ball, has a motion of translation in the direction of the arrow *AB*, and a motion of rotation in the direction of the curved arrow *CBD*. It is evident that the resistance of the air is not equal on all parts of

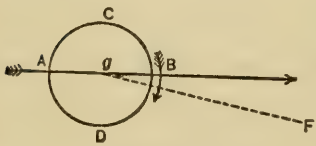


FIG. 6.

the ball, and that the ball will move in the direction of least resistance. The hemisphere *ACB* has more resistance than the hemisphere *BDA*, because the velocity with which the hemisphere *ACB* moves through the air is the velocity of translation of the sphere *plus* the velocity of rotation of the hemisphere *ACB*, which is rotating in the direction of the motion of translation of the sphere; while the motion with which the

hemisphere *BDA* moves through the air is the velocity of translation of the sphere *minus* the velocity of rotation of the hemisphere *BDA*, which is rotating in the opposite direction to the motion of translation of the sphere.

That is, the resistance of the air to the side *C* is greater than to the side *D*, and the projectile moves off toward the side of least resistance along the line *gF*. The drift is a curve; for while the velocity of translation becomes rapidly less from the air resistance, the velocity of rotation dies away very slowly.

If the anterior hemisphere rotates from right to left, the drift is to the left, and *vice versa*.

If the anterior hemisphere rotates from above, downward, the drift is downward, and *vice versa*.

In this latter case the range is diminished or increased, as the case may be.

Now, in order to do away with these accidental drifts for which no allowance can be made, spiral grooves are cut in a rifled barrel so that the bullet will always rotate in the *same* direction, and on an axis parallel to the axis of the barrel and tangential to the trajectory.

The effect of rotation given the bullet by the grooves is, that the equalities are made to revolve,

as it were, about a common axis. There will still be a lateral drift, always in the direction in which the top of the sphere is rotating (for the same reason as was explained before); but as this drift is now reduced to a practically constant quantity, allowance can be made for it by adjustments of the sights.

The Drift of Elongated Projectiles

The foregoing explanation will not account for the drift of elongated projectiles, which is altogether a different and more complicated matter. It is often stated that an elongated projectile drifts laterally, because in falling through the air the resistance is greater on the under than on the upper surface. This slight difference in pressure could account for but little drift during the short time that the bullet is in flight; and while it takes account of lateral drift, we know from theory and experiment that an elongated projectile drifts in every direction, as viewed from the gun. This "spiral" drift is illustrated by the gyroscope, and a few years ago Mr. E. A. Leopold measured a number of these spirals with great accuracy by shooting through screens.

We will first consider an elongated projectile,

with a more or less pointed head, and having its centre of gravity situated behind the centre of form, as is general with projectiles in use to-day. Let us suppose (Fig. 7) that the projectile is shot from a smooth-bore gun, and that it has no motion of rotation; also that it is fired at some angle of elevation with the horizontal plane *AB*.

We may suppose that the centre of gravity, *G*, is a pivot; and since the resistance of the air is

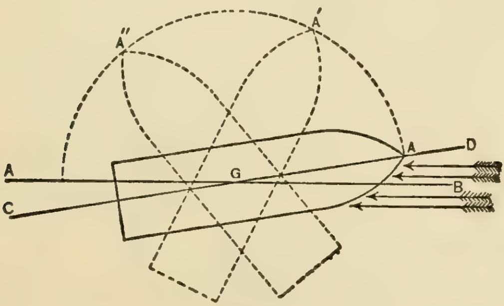


FIG. 7.

strongest on the under side of the head, as indicated by the arrows, the head will be elevated more and more; and since the centre of gravity is behind the centre of figure, the lighter forepart of the projectile will be forced completely over until the projectile travels with its heaviest end or base foremost.

If now we consider this same bullet fired from a rifled barrel, so that it will have a rapid motion of rotation about its longer axis, we shall see that it is acted upon by two conflicting forces: the motion of rotation about its longer axis, given it by the grooves, which tends to keep the projectile in its original direction; and the resistance of the air, which tends to turn the projectile over, about a shorter axis passing through the centre of gravity, because the longer axis does not remain tangent to the trajectory, it being constantly deflected from it by gravity, so that the resultant of the air's resistance does not pass through the centre of inertia of the projectile, but above or below it, as the case may be, — in this instance above it, since the centre of gravity is behind the centre of form. It is known that a body acted upon in this manner will not yield fully to either force. The resistance of the air will first elevate the point, and this upward drift is the beginning of all drift; then the point will move slowly off to the right or left, in the direction in which the bullet is rotating. In further explanation of this drift I shall use Mr. Bashforth's figures for illustration.

Suppose we view the flight of the projectile from behind the gun, and that the projectile is

rotating to the right; now the resistance of the air will at first elevate the apex (position 2), and from what has preceded the point will move to the right (position 3), and will continue to move to the right until it reaches position 4, at which point the drift is entirely horizontal and to the right. It is evident that up to this point the projectile has drifted both upward and to the right; for as soon as the axis of the shot begins to move to the right, the left side of the projectile receives the greatest resistance, and the projectile is forced to the right. Now, in Figure 9, the axis of the shot *ab* does not remain parallel to *AH*, but is constantly dipping away from it. At low angles of elevation the axis *ab* dips more rapidly than the tangent to the trajectory *ot*, and the projectile will assume the several positions, 5, 6, 7, etc., of Figure 8, and go on rotating throughout its flight. That it *may* make several

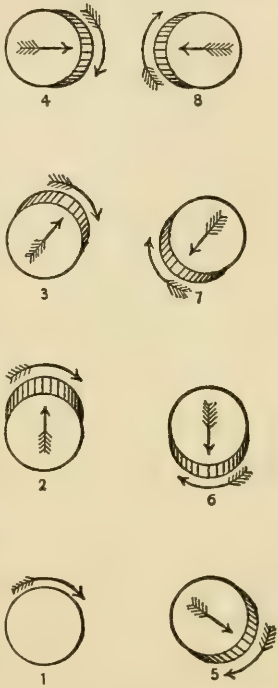


FIG. 8.

complete revolutions and have a drift in all directions, even over a comparatively short range, has been proven. There seems, at first sight, to be no reason why there is a greater drift to the right than to the left, except for the fact that the resistance, and hence the deflection, is greatest at first,

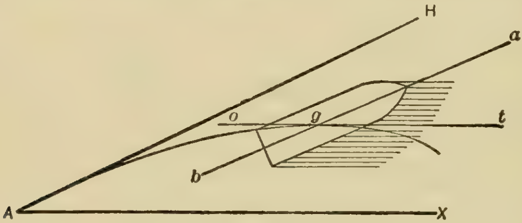


FIG. 9.

when the point of the projectile is moving to the right, and that the resistance is greater on the under side of the projectile; but Mr. Bashforth points out that when the point of the shot is to the right of the plane passing through the tangent, the tangent to the trajectory and the axis of the projectile are both dipping downward; but when the point of the shot is to the left of the vertical plane passing through the tangent, the tangent is dipping downward as it constantly does, but the axis of the shot is rising upward. Therefore the drift is in operation a longer time to the right than to the left. The upward or vertical drift exceeds the

downward drift, and the drift to the right greatly exceeds that to the left; so that the resultant drift observed in practice seems to be wholly to the right. With a left-handed rotation all this is reversed.

Any factors which cause an increase in vertical drift lead to inaccuracy of fire; for instance, in the light, hollow-pointed express bullet the centre of gravity is situated very far back; and as this bullet is fired at high velocity, its drift becomes excessive, and often erratic, so that in firing through screens at 200 yd. the spiral is so wide that the 100-yd. height may seem lower than the 150-yd. height, having happened to pass through the screens at that particular part of its spiral flight. We have seen a bullet show a spiral as wide as 10 in., but this is very exceptional; and in an accurate "steady" bullet the width of spiral may be only a fraction of an inch, or may be contained within the diameter of the bullet. Drift may be very much exaggerated and the flight of the bullet made erratic, if the bullet be mutilated, or if it is not properly centred in the bore so that its axis coincides with the axis of the bore.

In the case of an elongated projectile having its centre of gravity in front of the centre of form, it

will generally travel point foremost; and if the angle of elevation and velocity of translation are low, the projectile may be accurate enough for sporting purposes. It is found that a 12-bore bullet of this kind, having its centre of gravity very far forward, and fitted with mechanical grooves in the cartridge case which gives to it a very low motion of rotation, is fairly accurate up to, say, 80 yd. or so; but if the velocity of translation and the angle of fire be high, the projectile is not steady or accurate unless given a very high velocity of rotation about its longer axis.

The resultant of the resistance of the air will act behind the centre, and the base will be forced up and the apex depressed. The base will be forced above the horizontal and then forced down again, the result being a very "wabbly" motion of the base during its flight.

The only projectile which does not drift in the direction of the rotation is the flat-headed cylindrical shot.

In Figure 10 the lines represent the resistance of the air, whose resultant acts along the line BA. The effect of the resultant acting between a and b is to depress the head of the shot and give it a motion of rotation about a shorter axis; the projectile

assuming the position indicated by the dotted line, —now with a motion of rotation to the height about its longer axis, — the face will be depressed by the resistance of the air, the rotary motion will resist this, and the head will move off slowly downward and to the left, leaving the face and right side exposed obliquely to the air's resistance, so that the projectile will be pushed bodily to the left, and the

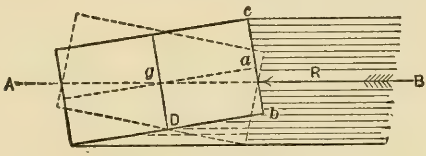


FIG. 10.

resultant of the drift will be to the left. If the velocity and angle of elevation are high, this left-hand drift is much more noticeable. The wind also has a great effect upon the drift of a bullet. A head wind reduces the speed, a rear wind increases it, and a side wind drifts a bullet in the direction in which it blows. Other things being equal, the larger the surface the wind acts on, the greater the deviation: light bullets are affected much more than heavy ones, and hollow-pointed bullets more than solid ones; short, light, hollow-pointed bullets are especially affected. It seems

that they actually "run down wind," as it were; but when one considers how easily a bullet — having the centre of gravity far to the rear — is turned from its course, we see how the light, hollow-pointed bullet is affected.

From what has gone before, it is evident that an elongated bullet requires the rotary motion which is imparted to it by the grooves to steady its flight. Long bullets will require more rotary motion, or a quicker twist to the rifle grooves, than short ones, for the resistance of the air has more surface upon which to act and overturn them. If the twist be insufficient, the bullet may wabble badly, or even turn over or keyhole; or again, if the range be long, the bullet may fly steadily for a distance and then gradually become more and more unsteady and inaccurate. So long as the bullet can take the grooves and is not forced out across the lands, — which is called "stripping," — a quick twist is found to be desirable. If two bullets be of the same length but different calibers, the larger will require less rotary motion to keep it steady, because its radius of gyration is larger. A light bullet made of iron requires a more rapid twist than does one of lead; for the former, being lighter, loses its rotary motion more rapidly. And a bullet

having a hollow through it requires less twist than a solid bullet of the same dimensions, for the effect of the hollow is to distribute the mass farther from the centre, thereby lengthening the radius of gyration. High muzzle velocities require quick twists, as the high velocity increases the resistance of the air.

The twist necessary for any particular bullet is generally found by trial, but Professor Greenhill has deduced a formula which gives very good results. In tabular form it is used as follows, for bullets made of 16 parts lead to 1 of tin:—

Length of Projectile in Calibers.	One Turn of the Rifling in Calibers.	Length of Projectile in Calibers.	One Turn of the Rifling in Calibers.	Length of Projectile in Calibers.	One Turn of the Rifling in Calibers.
2.0	84.29	3.5	42.40	5.0	28.44
2.1	78.98	3.6	41.05	5.1	27.83
2.2	74.32	3.7	39.79	5.2	27.24
2.3	70.20	3.8	38.61	5.3	26.68
2.4	66.53	3.9	37.48	5.4	26.14
2.5	63.24	4.0	36.43	5.5	25.63
2.6	60.26	4.1	35.43	5.6	25.13
2.7	57.55	4.2	34.49	5.7	24.66
2.8	55.09	4.3	33.59	5.8	24.20
2.9	52.72	4.4	32.74	5.9	23.75
3.0	50.74	4.5	31.94	6.0	23.33
3.1	48.82	4.6	31.21	7.0	19.78
3.2	47.04	4.7	30.44	8.0	17.18
3.3	45.38	4.8	29.74	9.0	15.18
3.4	43.84	4.9	29.07	10.0	13.60

We have always been in the habit of speaking of the length of a bullet and the turn of the twist in inches, but it is more correct to reckon them in calibers.

To reduce the length of a bullet from inches to calibers, simply divide its length by its caliber in inches. Thus a .50-cal. bullet 1½ in. long is 3 cal. in length. A .25-cal. bullet 1 in. long is 4 cal., etc.

As an example in the use of the table: Suppose it is required to find the minimum twist necessary for a .45-cal. bullet 1.35 in. long. Dividing 1.35 by .45, we find that the projectile is 3 cal. long, and opposite the number 3, in the table, we find 50.74, or the bullet requires a turn in 50.74 cal. To reduce this to inches, multiply the twist in calibers by the diameter of the bullet in inches (50.74 × .45), which gives about 22 in.

When Mr. Harwood ("Iron Ramrod") designed the .22 Hornet cartridge, he found that the usual twist of one turn in 14 in. was too slow for the .63-gr. bullet, but that in a twist of one turn in 12 in. it shot steadily. The .63-gr. bullet was .66 in. and measured .23 in. in diameter, or almost 2.9+ cal. long. Opposite 2.9 in the table we find 52.72; that is, 52.72 × .23 = 12.1 in.

Now, the velocity with which the bullet will

rotate on leaving the barrel is not dependent upon any form of grooving; it is immaterial whether the twist be uniform, or whether it increases in pitch from breech to muzzle. The number of revolutions made by the bullet per second depends upon the muzzle velocity and the twist at the muzzle of the gun.

To find the number of revolutions per second, divide the muzzle velocity by the product of the bullet's diameter by the turn of the twist, or

$$\text{number of revolutions per sec.} = \frac{V}{ND}, \text{ in which}$$

V = muzzle velocity in foot-seconds.
N = turn of the twist in calibers.
D = the diameter of the projectile in inches.

Since the muzzle velocity and the diameter of the projectile must be expressed in the same unit, either feet or inches, it is easier to multiply the velocity by 12 and reduce it to inches than to reduce the diameter of the bullet to feet.

Example

Given, a .25-cal. rifle having one turn in 15 in. Find the number of revolutions per second of a bullet that has muzzle velocity of 1500 ft.-sec.

First reduce the twist in inches to calibers by dividing 15

by .25, which gives 60 cal.; then substituting values in the formula, we get

$$\text{number of revolutions per sec.} = \frac{1500 \times 12}{25 \times 60} = 1200.$$

A simpler way is to divide the muzzle velocity in inches by the twist in inches, as follows:—

$$\frac{1500 \times 12}{1500} = 1200 \text{ revolutions per second.}$$

After years of trial there appears to be no especial advantage in any one of the different forms of grooving. All shoot well if accurately bored. The grooves are usually from two to five thousandths of an inch deep. For patched bullets the grooves are shallower than for naked bullets.

Recoil in Guns

Upon the ignition and "explosion" of the powder charge, a large quantity of highly elastic gases are liberated. These exert their pressure in every direction. The pressures on the base of the bullet, the walls, and base of the chamber or cartridge case are proportionately equal, and when sufficient pressure is exerted the bullet is moved from its seat or is set in motion; but these same pressures which act upon the bullet and move it react upon the gun, which, being much heavier, does not yield so soon to their influence. Some minute

interval of time may also be lost, owing to the non-solidity or lost motion of the parts; but usually the gun has moved backward over a portion of its path of recoil before the bullet has quitted the muzzle, and the recoil goes on accumulating and reaches its maximum after the bullet has left the barrel. It is an established principle that whatever the force be that acts, there must be a corresponding and equal reaction; and were it not for the great proportionate difference in the weights of the bullet and the gun, we could not stand up under the recoil at all. The force which moves the bullet and the column of air in front of it, reacts directly upon the gun.

The force which continues to act on the base of the bullet, and causes it to overcome the friction of the grooves, also reacts upon the gun. And after the bullet has left the barrel the imprisoned gases and the residues rush out against the air, and these also react upon the gun; and the gases will continue to issue forth until the pressure of the confined gases equals the pressure of the outside air.

Formerly it was thought that the gases rushing out left a vacuum in the barrel, and that the air suddenly filling up this vacuum caused the recoil.

One of the sixteenth-century authors states that in discharging a large piece of ordnance the suction was so great as to draw in an unfortunate dog which happened to be standing near.

If the gun is left free to move backward, it will travel over a certain path; and if stopped suddenly at any point of this path, the resistance must be high and sudden and the result will be a severe blow. It is not well to hold the gun loosely, nor *too* tightly, against the shoulder, but in such a manner that the effect of the recoil is a steady push.

There are various gauges to determine the recoil of guns; they are more or less accurate, but the formulæ for the determination of recoil are somewhat complicated and not very trustworthy, so they are omitted. Various devices are used on guns shooting large charges, their principle being to lengthen the path of recoil and thereby reduce its severity. Soft rubber pads are the most satisfactory, and the recoil is often reduced by one-fifth or one-fourth of its total amount by their use, as may be easily proved.

The heavier the bullet or charge of powder, the greater the recoil; likewise, the higher the velocity and the lighter the gun, the greater the recoil.

The unpleasant effects we experience from recoil depends mostly upon the velocity of the recoil. With a high velocity of recoil the blow is sudden and sharp, as with a light gun, or when using fine-grain or quick-burning powder, which generates a high pressure in a very short time compared to the coarser, slower-burning grains. The difference in the feeling of the recoil from black and nitro powders is quite marked, and is due to the weights of the powders and their residues, and the manner in which the pressures are distributed. The difference in the total energy of their recoils is not so great, however, as one might expect.

Besides the direct recoil of the gun, there are the phenomena known as "jump" and "flip."

The effect of jump is that the muzzle is rotated upward, often causing the bullet to leave the muzzle at a higher angle of elevation than it otherwise would.

The line of application of the force of recoil is directly back through the axis of the bore and the centre of the breech-block. The point of resistance to this force is below it, through the butt of the gun, so that the whole piece is thrown upward.

In the use of ordnance the angle of jump is always known and allowed for, and it is added to the angle of elevation, otherwise the range would be greater than the angle of elevation calls for, and the trajectory would appear much too low. Jump is most noticeable in the revolver, where the point of resistance is situated low down, owing to the shape of the butt, and with full charges the front sight is often so high that the axis of the bore actually makes an angle of depression with the horizontal plane, in order to allow for the effect of jump. In the .45-cal. Colt's revolver, using the full army charge, instead of angles of elevation, there are angles of depression to counteract the effects of jump up to over 250 yd.

The angle of jump varies with the charge of powder and weight of bullet, and a gun that is shot from rest will generally show more jump than one shot off-hand.

Now, it happens that if the barrel is thin and tapering, or the grip thin and weak, the gun muzzle, instead of rotating upward, will at first be depressed. This depression of the muzzle is termed "flip."

The barrel, if thin, actually bends, and it has been found that nearly all long barrels exhibit

flip to a greater or less extent; and it begins before the bullet has left the barrel, so that the bullet leaves the barrel at a lower angle of elevation than the sights record. Flip generally increases as the charge is increased, thus producing the anomaly of the bullet's falling lower on the target as the velocity increases; and it seems that the more rigidly a gun is held, — in a vise, for instance,— the more irregular flip is. This is the principal reason that it is difficult to make a double rifle shoot accurately; and if regulated for one charge, they seldom shoot another so well. If a single barrel be intended for fine target shooting, it should be heavy; for a slight difference in the friction, amount of fouling, or muzzle velocity will affect the shooting of a light barrel that is sensitive to flip. For these reasons be careful to place the barrel always on the same spot when shooting from rest. I once owned a 32–40 rifle with a light barrel, which was extremely sensitive to every change of condition. Firing at a spot 50 yd. distant at the same height as the axis of the bore and having the sights parallel with the axis of the bore, using 40 gr. of powder and a 165-gr. bullet, giving a muzzle velocity of about 1470 ft.-sec., I found that the drop of the

bullet averaged about 9 in. below the axis of the bore produced, while from the muzzle velocity we should expect a drop of about 2.2 in.; so that to account for the difference the gun muzzle must have been depressed about $\frac{1}{10}$ of an inch when the bullet left the barrel. Then reducing the powder charge little by little, the bullets struck higher and higher, until after a certain limit they again began to drop lower and lower; and when 28 gr. were used, the bullet again fell 9 in. below the axis of the bore, having the same apparent drop as the 40-gr. charge.

Now, it is evident that the bullets shot with the greatest charge of powder had the highest velocity and the lowest trajectory curve; but the variation in the amount of flip gave to each a different base line. It is therefore not always safe when making screen trajectories to consider the horizontal line from centre of bore to target as the true base line, for the muzzle may be slightly and irregularly depressed at each shot. Lack of care in these small details no doubt causes some of the puzzling trajectory curves which are from time to time published as the result of screen tests.

THE PISTOL AND REVOLVER

By A. L. A. Himmelwright

THE PISTOL AND REVOLVER

PISTOL-SHOOTING as a pastime has been practised since the time of the discovery of gunpowder. It is only recently, however, that it has been recognized as a legitimate sport.

The useful and practical qualities of the pistol and revolver have been developed almost wholly during the last half-century. Before this period the small arms designed to be fired with one hand were crude and inaccurate, and were intended to be used only at short range as weapons of defence. The single-barrelled muzzle-loading pistol has, nevertheless, been part of the army and navy officer's equipment since the sixteenth century. These pistols were of large caliber, smooth-bored, heavy, and unwieldy. The load was a spherical bullet and a large charge of powder. Enough accuracy was obtained to hit a man at 15 to 20 paces, which was deemed sufficient. The usefulness of these arms in action was limited to the firing of a single shot, and then using them

as missiles or clubs. The pistol in early days was considered a gentleman's arm — a luxury. It was the arm generally selected for duelling when that code was in vogue, the contestants standing 10 to 20 paces apart and firing at the word of command.

The development of the pistol has been contemporaneous and closely identified with that of the rifle. With the grooving or rifling of the barrel, the accuracy was greatly improved and the arm adapted to conical bullets. Although numerous attempts were made to devise a multi-shot arm with flint, wheel, and match locks, it was not until the percussion cap was invented that a practicable arm of this character was produced. This was a "revolver" invented by Colonel Colt of Hartford, Conn., and consisted of a single barrel with a revolving cylinder at the breech containing the charges, the mechanism being such that the cocking of the piece after each discharge revolved the cylinder sufficiently to bring a loaded chamber in line with the barrel. The greatest advance in the development of firearms was the introduction of the system of breech-loading, employing ammunition in the form of cartridges. This principle rendered the operation of loading much simpler

and quicker, and vastly improved the efficiency and general utility of the arms.[1]

The present popularity of pistol and revolver shooting is due, no doubt, to recent improvements in the arms and ammunition. The arms are now marvels of fine workmanship, easy to manipulate, durable, and extremely accurate. With the introduction of smokeless powders, the smoke, fouling, and noise have been reduced to a minimum. The effect of these improvements has been, not only to increase the efficiency of the arms, but also the pleasure of shooting them.

As a sport, pistol shooting has much to commend it. It is a healthful exercise, being practised out-of-doors in the open air. There are no undesirable concomitants, such as gambling, coarseness, and rough and dangerous play. In order to excel, regular and temperate habits of life must be formed and maintained. It renders the senses more alert and trains them to act in unison and in

[1] For a detailed history of the evolution of the pistol and revolver, the reader is referred to "Text-book for Officers at Schools of Musketry," Longman & Co., London; "Kriegstechnische Zeitschrift," Heft I and II, 1901, Mittler & Sohn, Berlin; "The Modern American Pistol and Revolver," Bradlee Whidden, Boston. Many interesting specimens of ancient and modern pistols and revolvers are owned and exhibited by the United States Cartridge Company of Lowell, Mass.

harmony. But, above all, skill in shooting is a useful accomplishment.

Any one possessing ordinary health and good sight may, by practice, become a good pistol shot. Persons who are richly endowed by nature with those physical qualities which specially fit them for expert shooting, will, of course, master the art sooner than those less favored; but it has been conclusively shown that excellence is more a question of training and practice than of natural gift. Some of the most brilliant shooting has been done by persons possessing a decidedly nervous temperament; but those of phlegmatic temperament will generally make more uniform and reliable marksmen.

It is much more difficult to shoot well with the pistol or revolver than with the rifle. The latter, having a stock to rest against the shoulder and steady one end of the piece, has a decided advantage in quick aiming and in pulling the trigger. The former, without a stock and being held in one hand with the arm extended so as to be free from the body, is without any anchor or support whatever, and is free to move in all directions. Consequently the least jar, jerk in pulling the trigger, puff of wind, or unsteadiness of the hand greatly

disturbs the aim. Intelligent practice will, however, overcome these difficulties and disadvantages to such a degree that an expert shot with a pistol or revolver under favorable conditions can equal a fair shot with a rifle at the target up to 200 yd. When the novice essays to shoot the pistol or revolver, the results are generally disappointing and discouraging; but rapid progress invariably rewards the efforts of those who persevere, and when once thoroughly interested in this style of shooting, there comes a fascination for it that frequently endures throughout a lifetime.

Arms

The term "pistol" is frequently applied indiscriminately to the single-shot pistol and the revolver. A marked distinction between these arms has gradually been developed. The pistol is now recognized as a single-shot arm, adapted for a light charge, and designed to secure extreme accuracy. Its use is limited almost exclusively to target and exhibition shooting.

The modern revolver is an arm with a revolving cylinder holding five or six cartridges, which are at the instant command of the shooter before it is necessary to reload. It is designed

for heavy charges, and is a practical and formidable weapon. Revolvers are made in great variety, and adapted for various purposes, such as military service, target shooting, pocket weapons, etc. The best grades of pistols and revolvers may be had at a reasonable price. The cheap grades with which the market is at all times flooded should be avoided. They are incapable of doing good work, and frequently are positively dangerous, on account of being made of inferior materials.

Military Arms. — The revolver and the magazine pistol are used for military service. To fulfil the requirements these arms must be strong, very durable, and withstand a great amount of hard usage without becoming disabled. The effectiveness, or "stopping power," is of prime importance. The caliber should be large, and the charge sufficiently powerful to give a penetration of at least 6 in. in pine. There has been a tendency in recent years to reduce the caliber of military revolvers. While this has resulted in increased velocity and penetration, and reduced the weight of the ammunition, it has not improved the stopping power of the arms.

The sights must in all cases be very substan-

tial, and solidly fixed to the frame or barrel. The trigger pull varies from 4 to 8 lb., the barrel from 4 to $7\frac{1}{2}$ in. in length, and the weight from 2 to $2\frac{3}{4}$ lb. Ammunition loaded with smokeless powder is now invariably used for military service.

The service revolvers as issued to the United States army and navy are the Smith & Wesson and Colt, both .38 cal., and taking the same ammunition. They have passed the prescribed series of tests as established by the United States government,[1] and represent, without doubt, the highest development of the military revolver.

The arms shown in Figs. 1 and 2 have solid frames, and the actions are almost identical, the cylinder swinging out to the left, on a hinge, when released by a catch. The shells may then be extracted simultaneously by pushing back the extractor rod. The Smith & Wesson has an additional locking device in front of the cylinder. The principal difference between these arms is in the shape of the handles.

Other excellent military revolvers are the Smith & Wesson Russian Model and the Colt

[1] See Ordnance Reports, Department of War, Washington, D. C., for complete details of tests, etc.

New Service, both .44 cal. The ammunition for these arms was formerly loaded with black powder; but smokeless cartridges have been adapted to them, which give slightly increased velocity and approximately the same accuracy.

The Smith & Wesson Russian Model has a hinge "tip-up" action, with an automatic ejecting device. The action is operated by raising a catch in front of the hammer. It is easy to manipulate, and, on account of the accessibility of the breech, the barrel can be readily inspected and cleaned. This arm is single action.

The action of the Colt New Service is similar to that of the .38-cal. revolver, shown in Fig. 2, with a solid frame. It is double action.

The foregoing arms, with good ammunition, are capable of making groups of ten shots on a 3-in. circle at 50 yd.

The Colt Frontier Model is one of the most popular arms for hard service. It has a solid frame and is double action. The arm is operated by opening a gate on the right-hand side, back of the cylinder. The cartridges are inserted in the cylinder through the gate, the cylinder being revolved by hand until the respective chambers come opposite the gate. In the same manner,

FIG. 1. — Smith & Wesson New Military Revolver.

Six shots; $6\frac{1}{2}$-inch barrel; weight, 1 lb., 15 oz.; .38 cal.

FIG. 2. — Colt New Army Revolver.

Six shots; 6-inch barrel; weight, 2 lb.; .38 cal.

FIG. 3. — Smith & Wesson Russian Model Revolver.

Six shots; $6\frac{1}{2}$-inch barrel; weight, $39\frac{1}{4}$ oz.; .44 cal.

FIG. 4.—Colt New Service Revolver.

Six shots; $5\frac{1}{2}$-inch barrel; weight, 2 lb., 8 oz.; .45 cal.

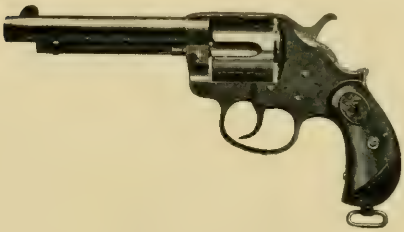


FIG. 5.—Colt Frontier Model Revolver.

Six shots; $5\frac{1}{2}$-inch barrel; weight, 2 lb., 5 oz.; .45 cal.

FIG. 6.—Webley "W. G." Army Model Revolver.

Six shots; 6-inch barrel; weight, 2 lb., 8 oz.; .455 cal.

the shells are ejected by pushing the extractor rod back into each of the chambers.

This revolver in .45 cal. was formerly the service weapon of the United States army, and is very powerful and durable.

The Smith & Wesson Schofield Model, .45 cal., was also formerly a United States service weapon. The ammunition for this arm, while less powerful than the .45 Colt, was admirably adapted for military service, and had much less recoil.

The Webley, "W. G." or "Army Model," revolver is an English arm of much merit. The calibre is .455. It has a hinge "tip-up" action, with an automatic extractor very similar to the Smith & Wesson.

The service weapon adopted by the Joint War Office and Admiralty Committee for the British army and navy is the "Webley Mark IV," or "Service Model," revolver. This model is almost identical with the Army Model, except that the barrel is 4 in. long and the weight is 2 lb. 3 oz. On account of the short barrel, the accuracy of this weapon does not equal that of the Army Model.

Another English arm is the "Webley-Fosbury" automatic revolver. The recoil revolving the cylinder and cocking the hammer, it can be fired

as rapidly as the automatic pistols. It is chambered for the .455 service cartridge loaded with $6\frac{1}{4}$ gr. of cordite. This arm has been introduced since 1900.

The magazine or automatic pistol, which is operated by the recoil, is the latest type of hand firearm. It has been perfected and introduced since 1899, and has almost double the velocity and range of the revolver. The Colt, Luger, Mauser, Mannlicher, and Mors are among the leading makes of this style of pistol. All of these arms have been tested by the United States government.[1] A limited number of the first two named are now (1903) being tried in the United States army.

In both the Colt and the Luger pistols the cartridges are inserted in clips and fed into the breech through the handle. In the Mauser pistol the cartridges are supplied in clips from the top and forced into a magazine located in front of the trigger.

The magazine pistols can be fired at the rate of about five shots per second. These arms equal the best military revolvers in accuracy.

[1] See Ordnance Reports, Department of War, Washington, D.C., for complete details of tests, etc.

FIG. 7. — Webley-Fosbury Automatic Revolver.

Six shots; 6-inch barrel; weight, 2 lb., $8\frac{1}{2}$ oz.; .455 cal.

FIG. 8. — Colt Automatic Pistol.

Seven shots; 6-inch barrel; weight, 2 lb., 5 oz.; .38 cal.

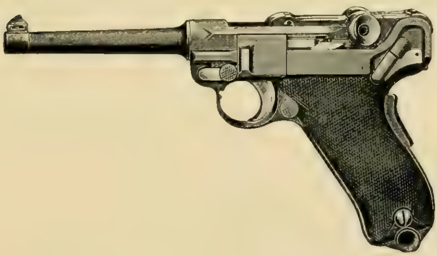


FIG. 9. — The Parabellum or "Luger" Automatic Pistol.

Eight shots; $4\frac{5}{8}$-inch barrel; weight, 1 lb., 13.4 oz.; .30 cal.

Many persons believe that the magazine pistol will soon supersede the revolver for general use. While this may be the case eventually, it is not likely to occur within the next few years. The magazine pistol is more complicated, and consequently more difficult to learn to shoot with and care for, than the revolver. On account of the special problems to be solved in the mechanism, many of them balance poorly and the trigger pull is almost invariably long and creeping. The novice will also have difficulty to avoid flinching in shooting these arms, on account of the recoil mechanism, louder report, etc. The line of sight being considerably higher than the grip, if they are not held perfectly plumb, or in the same position at each shot, the shooting is liable to be irregular. The cost is about double that of a good revolver. Until these undesirable features and disadvantages can be remedied or eliminated, the revolver will probably remain a popular arm.

Target Arms.—For target purposes the greatest possible accuracy is desirable. To obtain this, many features essential in a military arm are sacrificed. Delicate adjustable sights are employed, the trigger pull is reduced, the length of the barrel is increased, the charge reduced, etc.

The most accurate arms available at the present time are the single-shot pistols manufactured by Smith & Wesson, Springfield, Mass.; The J. Stevens Arms & Tool Co., Chicopee Falls, Mass.; The Remington Arms Co., Ilion, N.Y.; and William Wurfflein, Philadelphia, Pa. These pistols are furnished in calibers from .22 rim-fire to .38 central-fire. The barrels are generally 10 in. in length and the trigger pull 2 lb. In the latest approved form these pistols are of .22 cal., specially bored and chambered for the rim-fire, long rifle cartridge. This is a light, clean, pleasant shooting charge, and may be fired many times with very little fatigue. Pistol shooting with arms of this caliber should, therefore, become a popular pastime for ladies as well as gentlemen.

The Smith & Wesson pistol has a tip-up action and an automatic extractor. It is made of the best materials and with the greatest care. The fitting and workmanship are superior to that of any other machine-made pistol. The action is similar to that of the Russian Model revolver.

The Stevens pistols are furnished in two other models for target-shooting. The "Lord" Model has a large frame and handle and a heavy barrel. Its weight is 2¾ lb. The "Conlin" Model

FIG. 10. — Mauser Automatic Pistol.

Ten shots; $5\frac{1}{2}$-inch barrel; weight, 2 lb., $7\frac{1}{2}$ oz.; .30 cal.

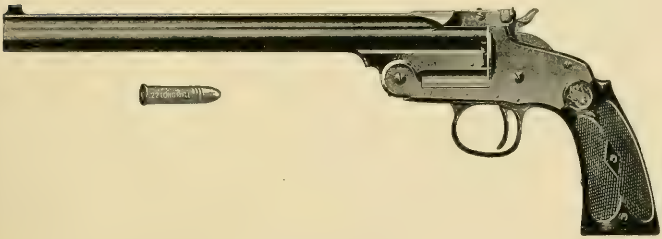


FIG. 11. — Smith & Wesson Pistol.

10-inch barrel; weight, 1 lb., $8\frac{3}{4}$ oz.; .22 cal.

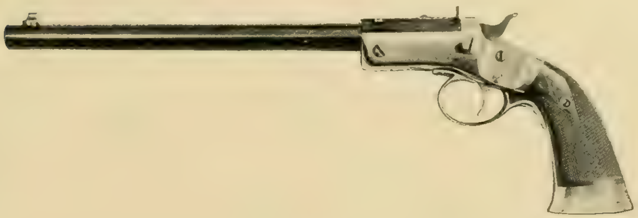


FIG. 12. — Stevens Pistol, Gould Model.

10-inch barrel; weight, 1 lb., 12 oz.; .22 cal.

FIG. 13.— Wurfflein Pistol.

10-inch barrel; weight, 2 lb., 2 oz.; .22 cal.

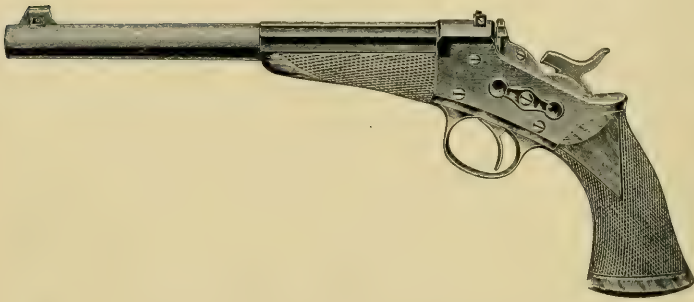


FIG. 14. — Remington Pistol.

10-inch barrel; weight, 2 lb., 8 oz. ; .44 cal.

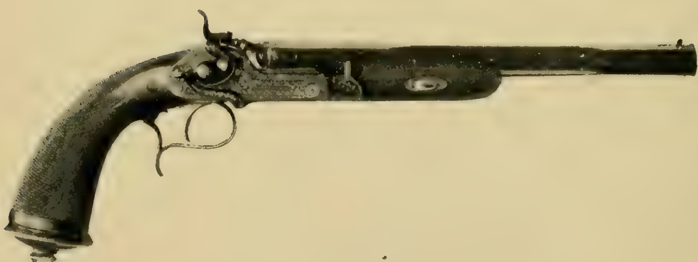


FIG. 15.—Gastinne-Renette Pistol.

$10\frac{3}{16}$-inch barrel; weight, 2 lb., 6 oz.; .44 cal.

is the same as the "Gould" Model, but has a spur added to the trigger guard. The Gould Model is the most popular. All these models have a tip-up action and an automatic extractor. A small knob on the left side is pressed to release the barrel and operate the action.

The Wurfflein pistol, like the Stevens, has a tip-up action. It is well made and has a handle very similar in shape to that of the duelling pistol of former days. The action is operated by releasing the catch on the handle, back of the hammer.

The Remington pistol has an exceedingly strong action, and is the only pistol that can be had chambered for the .44 Russian cartridge. It has a large handle and a heavy barrel. The action is operated when the hammer is at half-cock by throwing back the breech-block with the thumb, simultaneously ejecting the empty shell.

With good ammunition all these pistols are capable of placing ten shots within a 2-in. circle at 50 yd.

A very accurate pistol for gallery and short-range shooting is made by M. Gastinne-Renette of Paris and used in his gallery in that city. These are muzzle-loading and very tedious and inconvenient to manipulate. For this reason

they have not become popular. A few of these arms have been made up as breech-loaders, with a tip-up action similar to the Stevens, and chambered for the .44 Russian cartridge. In this form the pistol has given very good results.

The revolver is not quite as accurate as the pistol, on account of the necessity of having the cylinder detached from the barrel. If the pin on which the cylinder revolves is not exactly parallel with the bore of the barrel, there will be more space between the cylinder and the breech end of the barrel in some positions of the cylinder than in others. The result will be varying amounts of gas escaping from the different chambers of the cylinder, and consequently irregular shooting. The accuracy of the revolver depends largely upon the degree of perfection in which all the chambers of the cylinder align with the bore of the barrel at the instant of discharge. When the chambers do not align perfectly, the bullet enters the barrel eccentrically and a portion of it is shaved off. This is fatal to accuracy, especially when smokeless powder is used. Imperfect alignment of chamber and barrel is also the most frequent cause of the "leading" of the barrel. Some very ingenious mechanical expedients are used in

the best revolvers to reduce to a minimum the wear of those parts which operate and hold the cylinder in position.

The revolvers generally used for target shooting are the military arms already described, chambered for special cartridges, fitted with target sights, special handles, and other modifications to suit the whims and tastes of individuals. The best and most experienced shots are, however, careful to keep the modifications of all their arms within the rules and regulations of the various national organizations,[1] in order that they may be used in the annual competitions and other important events. These organizations control pistol and revolver shooting, and conduct annual competitions. "Freak" arms which do not comply with the rules are not allowed in the competitions, are seldom practical, and have little or no value other than for experimental purposes. Target arms are generally used for trick and exhibition shooting.[2]

[1] The United States Revolver Association, The National Rifle Association of Great Britain, and the United Shooting Societies of France. For programmes and details, address the secretaries of the respective organizations.

[2] For descriptions and illustrations of this style of shooting, see "The Art of Revolver Shooting," G. P. Putnam's Sons, New York and London. This elaborate work contains also much detailed information, valuable sug-

Pocket Arms. — The most extensive use of the revolver as a pocket weapon is for police service. Special arms are manufactured to meet the requirements. These weapons are generally similar to the military revolvers, but adapted for lighter charges, and consequently weigh less. All projections, such as sights, hammer, etc., must be eliminated or minimized so as not to catch in drawing the arm from the pocket or holster. The barrels are from 3 to 5 in. in length, the trigger pull 4 lb., and the caliber usually .32 or .38. Of these two calibers, .38 is much preferable for the general purposes of an arm of this character. The difference in weight is slight, while the power and effectiveness of the larger caliber is almost double that of the smaller.

The pocket arms shown in Figs. 16 and 17 are practically miniatures of the military arms shown in Figs. 1 and 2. They have solid frames and actions identical with those of the military arms. They are made only in .32 cal., and are double action.

One of the most recent pocket revolvers is the Smith & Wesson Safety Hammerless. This arm

gestions, and many interesting personal experiences in relation to revolver shooting.

FIG. 16. — Colt New Police Revolver.

Six shots; 4-inch barrel; weight, 18 oz.; .32 cal.

FIG. 17. — Smith & Wesson Pocket Revolver.

Six shots; $4\frac{1}{4}$-inch barrel; weight, $18\frac{1}{2}$ oz.; .32 cal.

FIG. 18. — Smith & Wesson Safety Hammerless Revolver.

Five shots; 4-inch barrel; weight, 1 lb., $1\frac{1}{4}$ oz.; .38 cal.

FIG. 19. — Stevens Diamond Model Pistol.

6-inch barrel; weight, $8\frac{3}{4}$ oz.; .22 cal.

has a safety clutch in the back of the handle, so designed that unless the piece is properly held it is impossible to operate it. It has many valuable and desirable features to commend it as a practical pocket weapon. The standard length of barrel is 4 in. This arm is also furnished in .32 cal.

With 4-in. barrels, the foregoing pocket weapons are capable of shooting regularly within a 2-in. circle at 12 yd.

A heavier and correspondingly more powerful pocket revolver is the Colt "Double Action" revolver. This arm is chambered for the Colt .41 cal. short and long cartridges. It has a solid frame, and is operated exactly like the Colt Frontier Model (Fig. 5). It is compact, strong, durable, and accurate.

The "Single Action Army" is another Colt revolver that has been extensively used as a belt or holster weapon. The mechanism and action are similar to that of the preceding arm, except that it is heavier and larger, and is single action.

A very handy little arm to carry in the pocket on hunting and fishing trips is the Stevens Diamond Model single-shot pistol. This pistol is very accurate, and can be depended on to kill grouse, ducks, rabbits, and other small game. The

.22-cal., short, hollow-pointed bullet should be used, or the regular .22 short cartridge, with the front of the bullet cut off square, so as to leave a flat point. This will increase the killing effect of the bullet considerably.

Ammunition

The degree of perfection that has been attained in the manufacture of ammunition is remarkable. Generally speaking, the smaller the charge the more difficult it is to make it accurate. Notwithstanding this, we have in the .22-cal. ammunition a tiny cartridge the accuracy of which falls little short of the marvellous. Until very recently, black powder ammunition was used almost exclusively for pistol and revolver shooting. In calibers larger than .22, smokeless powders are now extensively used, especially in military shooting, where the regulation full charge is required. In the .22-cal. pistols, the fouling of the black powders is not a very serious matter, and it is not uncommon to shoot fifty or a hundred rounds without the necessity of cleaning. In the larger calibers, however, the fouling is frequently so excessive that it affects the accuracy after the tenth shot. The incessant cleaning that is necessary in order to get good

results with black powder ammunition was a great drawback, and detracted much from the pleasure of revolver shooting. Fortunately this objection is now entirely eliminated by the use of smokeless powders.

To give good results, the proportions of any given charge must be adapted to the caliber, length of barrel, and weight of the arm in which it is to be used. These proportions are generally determined by experiment. The accuracy of the cartridge depends largely upon the uniformity exercised in the loading. In factory-loaded ammunition for military service, the shells are generally crimped on the bullets, to hold them rigidly in position. This does not improve the accuracy, but is a practical necessity. Reduced or "gallery" ammunition, designed to be used indoors and at short range, is made in great variety. A spherical bullet is generally used, and gives fairly good results up to 25 yd.

Rim-fire Cartridges. — These contain fulminate of mercury for priming around the outer edge of the rim, or base of the shell, and are generally loaded with black powder.

The ".22-cal. long rifle" cartridge is more extensively used for pistol shooting than any

other. It is the most accurate of the .22-cal. cartridges, being well proportioned, the bullet well lubricated, and the shell uncrimped.

In addition to this, the ammunition is inexpensive and has very clean shooting qualities. It is, therefore, particularly well adapted for pistol

FIG. 20. — Powder, 5 gr.; bullet, 40 gr.; exact cal., 0.223.

FIG. 21. — Powder, 3 gr.; bullet, 30 gr.; exact cal., 0.223.

shooting. This cartridge, fired from a 10-in. barrel, will shoot regularly inside of a 2-in. circle, at 50 yd., and inside a 5-in. circle, at 100 yd.

Another excellent cartridge in this caliber is the ".22 short." Like the preceding, this cartridge fouls very little and gives almost equal accuracy up to 50 yd. On account of its lighter report it is preferred by many for gallery shooting. In both of these cartridges only the surface of the bullet outside of the shell is lubricated. Exposed in this way, the lubricant is easily rubbed off, or melted if allowed to stand in the sunlight on a warm day. Great care should be taken to prevent this, as, without lubrication, the bullets will lead the barrel and cause inaccurate shooting.

The 22-cal. Winchester is a cartridge with inside lubrication. It is more powerful than the .22 long rifle, and gives good results in the pistol. The bullet has a flat point, making it suitable for game shooting, and the lubrication being within the shell, these cartridges may be carried loose in the pocket.

FIG. 22. — Powder, 7 gr.; bullet, 45 gr.; exact cal., 0.223.

All the .22-cal. cartridges can be had with hollow-pointed bullets, which are to be preferred for game-shooting. They are also furnished loaded with smokeless powder. When this powder was first used in .22-cal. ammunition, the results were far from satisfactory, but as now manufactured the smokeless ammunition approximates very closely in uniformity and accuracy to that loaded with black powder. The Winchester Repeating Arms Company has recently produced an alloy "greaseless" bullet in this caliber which, it is claimed, does not require lubrication. Should this claim be substantiated by actual experience, these bullets will probably supersede those of pure lead in these calibers.

The .25-cal. Stevens is a much more powerful cartridge than any of the preceding, and gives

excellent results in the pistol. It is selected by those who wish a more powerful rim-fire cartridge than is furnished in .22 cal.

Rim-fire cartridges in larger caliber than .25 are used for derringers (large-bore, single-shot pocket-pistols now seldom used) and inferior grades of revolvers. These cartridges sometimes lack uniformity in caliber when made by different manufacturers, are frequently defective, and discharge occasionally in closing the action of the arm in which they are loaded. They consequently lack the safety, reliability, and accuracy of the corresponding calibers in central-fire ammunition. Rim-fire cartridges cannot be reloaded.

FIG. 23.—Powder, 11 gr.; bullet, 67 gr.; exact cal., 0.257.

Central-fire Cartridges.—This type of cartridge has a brass or copper primer charged with a small quantity of fulminate of mercury, and containing a skeleton anvil of brass. The primer fits water-tight in a socket in the centre of the base of the shell. After being discharged, the primer can be renewed and the shell reloaded. In all the central-fire cartridges the lubrication of the bullet is inside of the shell, rendering this ammuni-

tion much more serviceable and less liable to be damaged.

The .32-cal. S. & W. cartridge is adapted to the Smith & Wesson, Colt, or other pocket revolvers.

FIG. 24. — Powder, 10 gr.; bullet, 88 gr.; exact cal., 0.313.

FIG. 25. — Powder, 13 gr.; bullet, 100 gr.; exact cal., 0.313.

Occasionally single-shot pistols are chambered for this cartridge. It is fairly accurate at ranges up to 50 yd. A gallery charge is furnished in this shell consisting of 4 gr. of powder and a spherical or "round" bullet weighing 47 gr.

The .32-cal. S. & W. Long is more accurate and powerful than the preceding cartridge. It gives excellent results in both the pistol and revolver. The gallery charge is the same as that of the .32 S. & W.

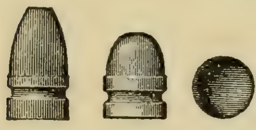
The .32-cal. Colt New Police is also an accurate cartridge, and was designed specially for the Colt New Police revolver. A gallery charge is furnished in this shell consisting of a powder charge reduced to 7 gr. and the regular bullet.

FIG. 26. — Powder, 13 gr.; bullet, 100 gr.; exact cal., 0.313

The .32–.44 S. & W. is a special target cartridge designed for the S. & W. Russian Model revolver. The bullet is seated inside of the shell, which is straight and uncrimped. The revolver may be chambered to take shells of either of the two lengths shown. The 17-gr. shell is generally preferred, as the 11–83 charge may also be loaded in it if desired. A gallery charge, consisting of 4 gr. of powder and a round bullet weighing 50 gr., may also be used in both shells. This affords a wide range of charges in one shell. A special feature of this cartridge is that the same sights used for the gallery charge at 12 yd. are suitable for the 11–83 charge at 50 yd. The full charge (17–98) in the long shell is the most accurate of all the black powder revolver cartridges. This ammunition, shot from a 6½-in. barrel, is capable of making ten-shot groups in a 2-in. circle at 50 yd., and a 5-in. circle at 100 yd. The 11–83 charge, under the same conditions, will also shoot in a 2-in.

FIG. 27. — Powder, 11 gr.; bullet, 83 gr.; exact cal., 0.323.

Powder, 17 gr.; bullet, 98 gr.



98 gr. 83 gr. 50 gr.

circle at 50 yd. The 4–50 charge will shoot in a 1-in. circle at 20 yd. This cartridge also gives good results in single-shot pistols.

The .38 S. & W. is adapted to the Smith & Wesson, Colt, and other pocket revolvers. It is much more powerful than the .32 S. & W., and is consequently more practical and better adapted for a pocket revolver charge. When shot from a 4-in. barrel, groups of ten shots can be made in a 2-in. circle at 20 yd., and in a 6-in. circle at 50 yd. The gallery charge is 6 gr. of powder and a round bullet weighing 71 gr.

FIG. 28.—Powder, 15 gr.; bullet, 146 gr.; exact cal., 0.358.

These two cartridges are adapted to the Colt and S. & W. Military revolvers. The first is the

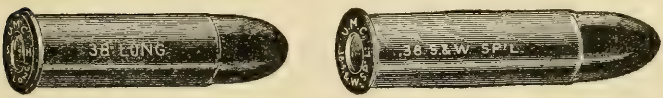


FIG. 29.

Powder, 18 gr.; bullet, 150 gr.

Powder, 21½ gr.; bullet, 158 gr.; exact cal., 0.358.

regulation service charge, and the second is a special target cartridge. Both are exceedingly accurate. From a 6-in. barrel six shots may be placed within a 6-in. circle at 100 yd. Smokeless

ammunition in this caliber gives equally good and uniform results; fifty to one hundred shots may be fired without cleaning and without sensibly affecting the accuracy.

The .38–.44 S. & W. is another cartridge designed for the S. & W. Russian Model revolver.

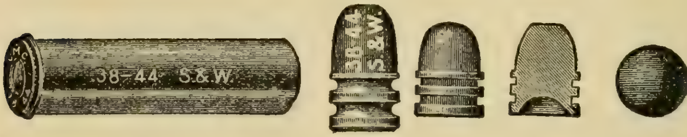


Fig. 30. — Powder, 20 gr.; bullet, 146 gr.; exact cal., 0.360.   146 gr.   110 gr.   100 gr.   72 gr.

It is more powerful than the .32–.44, but on account of the excessive fouling of this charge as now manufactured, the accuracy is impaired after the seventh shot. With an improved cleaner-shooting charge it would be accurate and extremely popular for target-shooting. This cartridge was originally designed and made for Chevalier Ira Paine, the noted pistol shot. Like the .32–.44, the shell is straight and uncrimped, and the bullet is seated in it so that the point is flush with its mouth. Several reduced charges have been developed for this shell. The Ideal Manufacturing Company can furnish moulds for a conical bullet with a square base weighing 110

gr., or with a concave base weighing 100 gr. The powder charge for either bullet is 9 gr. This charge works well up to 50 yd. A smaller load is the regulation gallery charge of 6 gr. of powder and a round bullet weighing 72 gr.

The .44-cal. Russian[1] is unquestionably the most popular revolver cartridge for target-shooting. While it has sufficient power to make it an effective charge for military service, it possesses, at the same time, remarkable accuracy. In the S. & W. Russian Model, or the Colt New Service revolver, the recoil is not so great as to be unpleasant, and the fouling is much less than that of many smaller charges. The fouling of the full charge load with black powder begins to "cake" or harden in the barrel after the twentieth shot, and, to get the best results, the barrel should be cleaned after every ten shots. Nearly all the great records in revolver shooting have been made with this ammunition, and most of the important matches have been won with it. A great deal of

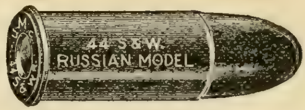


FIG. 31.—Powder, 23 gr.; bullet, 246 gr.; exact cal., 0.429.

[1] So named after its adoption as the service ammunition of the Russian cavalry.

experimental work has been done with this cartridge, and many reduced charges have been evolved. The Ideal Manufacturing Company can furnish moulds for the following bullets: —

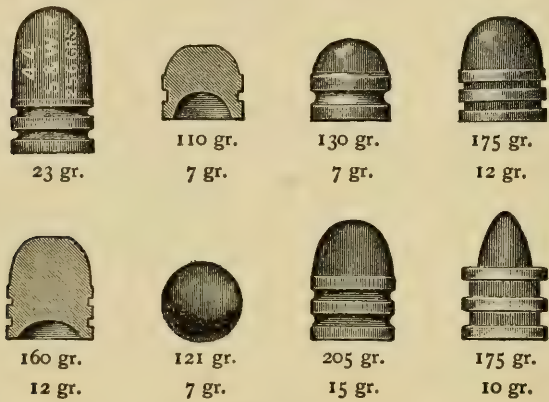


FIG. 32.

FIG. 33. — Powder, 40 gr.; bullet, 250 gr.; exact cal., 0.454.

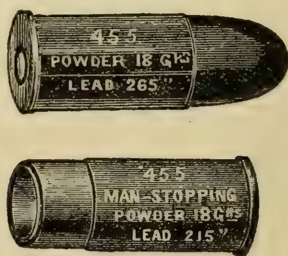


FIG. 34.

The weight of each, with the corresponding powder charge, is given. These various loads adapt this shell to almost any conceivable require-

ments in revolver shooting. The accuracy of the various charges fired from a 6½-in. barrel is as follows: —

Charge	Diameter of Circle Enclosing Group of 10 Shots				
	20 yds.	30 yds.	50 yds.	100 yds.	200 yds.
23–246	1 in.	1½ in.	2½ in.	6 in.	15 in.
7–110	1 in.	2 in.			
7–130	1¼ in.	2½ in.			
12–160		2 in.	3 in.		
12–175		2½ in.			
7–120	1¼ in.	2½ in.			
15–205		2 in.	3 in.	7 in.	
10–175	1¼ in.				

Revolvers are sometimes chambered for the .44–40–200, the .38–40–180, and the .32–20–115 rifle cartridges. These charges are not as accurate as the .44 Russian, but can be relied on to shoot inside a 5-in. circle at 50 yd. These cartridges are desirable only when it is an advantage to use the same ammunition in the rifle and revolver, or in certain localities where only a few varieties of ammunition are to be had. The large powder charge makes the recoil of the first two cartridges named rather unpleasant. The 32–20

–115 is the most accurate of these cartridges, and gives the best results in the pistol or revolver. All these cartridges having flat-pointed bullets are well adapted for game shooting. There are no gallery loads for these cartridges.

The .45 Colt Army is the most powerful of all the revolver cartridges. It was formerly the United States army service ammunition. The charge was so heavy, and the recoil so excessive, that it was almost impossible to shoot it without flinching. The service charge was afterward modified to 28 gr. of powder, which made it much more desirable and serviceable. With the latter charge this cartridge is very similar to the .45–30–250 Scofield Model S. & W. cartridge. Both of these are sufficiently powerful, accurate, and clean-shooting to render them suitable for military service. The gallery load for the .45 Colt is 7 gr. of powder and a round bullet weighing 139 gr.

The caliber of the service ammunition for the revolver of the British army is .455. This is a very accurate cartridge, but not as powerful as the corresponding military cartridges as used in this country. A special cylindrical bullet with a deep convex hollow point is furnished in the same shell and is known as the "man stopper."

This form of bullet is used in the .450 and .38 cal. cartridges also. The .450–13–225 is another English cartridge that is accurate, and pleasant to shoot. It is used largely at Bisley in the annual revolver competitions of the National Rifle Association of Great Britain.

In order to avoid excessive fouling, a self-lubricating bullet has been invented and introduced by Smith & Wesson, which can be furnished

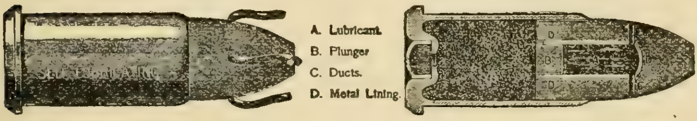


FIG. 35. — Self-lubricating cartridge.

Section showing details of construction.

in all calibers above .32. The bullet has a hollow core open in the rear. Lubricant is filled into the core, after which it is closed with a lead plunger. Four small ducts communicate from the forward end of the core to the exterior of the bullet just ahead of its bearing on the barrel. At the moment of discharge the plunger is driven forward, forcing the lubricant through the ducts into the barrel ahead of the bullet.

This bullet has given excellent results. With it a hundred or more shots may be fired with

black powder ammunition without causing sufficient fouling to impair the accuracy.

Nearly all the cartridges that have been referred to were originally designed for black powder. The various manufacturers can now furnish most of these loaded with smokeless powder at a very slight advance in price. The cartridges are loaded so as to give approximately the same velocity as black powder. The accuracy and uniformity with smokeless powder was not at first equal to that of the black; but with a better knowledge of the action and behavior of smokeless powders this difficulty has been overcome, and the smokeless equivalent in this ammunition now gives, not only substantially the same results as that loaded with black powder, but also causes much less fouling and smoke, and has a lighter report. These advantages will, no doubt, soon be generally recognized, and smokeless powder will supersede black for general sporting purposes just as it has for military service.

Most of the smokeless charges that have been adapted for the black powder cartridges are still in the experimental stage. For this reason the manufacturers who have developed satisfactory smokeless charges are unwilling to make them

public at the present time, preferring to wait until they have been thoroughly tested and tried. The following factory-loaded smokeless cartridges have been found equally as accurate as the corresponding black powder ammunition: —

Cartridge	Diam. of Bullet	Bullet and Weight in Grains	Brand of Powder and Weight in Grains	Distance of Crease from Mouth of Shell
.38 Long Colt . . .	.359	Conical, 150 gr.	3.2 gr., Laflin & Rand Bullseye	.37 in.
.38 S. & W. Special	.359	Conical, 158 gr.	3¾ gr., Laflin & Rand Bullseye	.33 in.
.38 S. & W. Gallery	.360	Round, 72 gr.	1.3 gr., Laflin & Rand Bullseye	.63 in.
.44 S. & W. Russian	.431	Conical, 246 gr.	3¾ gr., Laflin & Rand Bullseye	.325 in.
.44 S. & W. Gallery	.432	Round, 121 gr.	2 gr., Laflin & Rand Bullseye	.47 in.

In all the above cartridges, the bullets are seated on the crease in the shell, leaving a much larger space in the shell than is actually occupied by the powder charge.

The following additional smokeless charges will also give equally good results: —

Cartridge	Diam. of Bullet	Bullet and Weight in Grains	Brand of Powder and Weight in Grains	Top of Bullet from Mouth of Shell
.38 S. & W. Special	.359	Conical, hollow base, 100 gr.	1.8 gr. Laflin & Rand Bullseye	.15 in. above
.44 S. & W. Russian	.431	Conical Anderton, 205 gr.	3.2 gr. Laflin & Rand Bullseye	.15 in. above
.44 S. & W. Russian	.431	Conical, hollow base, 160 gr.	2.3 gr. Laflin & Rand Bullseye	⅛ in. below
.44 S. & W. Gallery	.431	Gallery conical, hollow base, 110 gr.	2.3 gr. Laflin & Rand Bullseye	¼ in. below
.44 S. & W. Gallery	.431	Gallery conical, hollow base, 110 gr.	4.6 gr. Hazard Blue Ribbon	.2 in. below
.44 S. & W. Gallery	.431	"Wad cutter," 175 gr.	4.0 gr. Hazard Blue Ribbon	Nose of bullet, ⅛ in. above

In developing some of the foregoing gallery charges, it was found that the amount of air space affected the accuracy to an extraordinary degree. The position of the bullet in the shell, as given in the last column, should be carefully noted when reloading. The bullets for the gallery charges should be alloyed with tin in the proportion of one part of tin to fourteen parts of pure lead.

With the introduction of the magazine pistol, special smokeless cartridges have been devised that are rimless and have a crease around the base by which they may be held and extracted by the

mechanism. This ammunition is furnished loaded with full mantled and "soft nose" bullets, the latter for hunting purposes.

Powder, 8 gr. (smokeless); bullet, 105 gr.; exact cal., 0.358.

Powder, 5¼ gr. (smokeless); bullet, 93 gr.; exact cal., .3016.

Powder, 7½ gr. (smokeless); bullet, 85 gr.; exact cal., .3008.

FIG. 36.

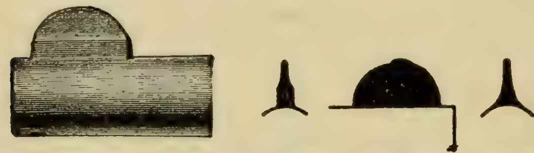
When fired from the regulation arms, this ammunition is capable of placing ten shots inside a 3-inch circle at 50 yd., and inside a 7-in. circle at 100 yd. These cartridges are exceedingly clean-shooting. Several hundred rounds may be fired without causing more fouling than is apparent after the first shot.

MUZZLE VELOCITIES AND PENETRATION

CARTRIDGE	LENGTH OF BARREL	MUZZLE VELOCITY		PENETRATION INCHES IN PINE
		Black Powder	Smokeless Powder	
.32 S. & W. . . .	6 in.	800	885	2¼
.32 Long Colt . . .	6 in.	748		4½
.32 Colt New Police .	4 in.	733	743	5
.38 S. & W. . . .	6½ in.	743	794	4½
.38 S. & W. Special .	6½ in.	763	784	7½
.38 Long Colt . . .	6 in.	794	789	5¾
.44 S. & W. Russian .	6½ in.	677	750	6½
.30 Luger Automatic .	4⅝ in.		1150	8
.30 Mauser Automatic	5½ in.		1340	10
.38 Colt Automatic .	6 in.		1250	7½

Sights

The purpose of sights is to assist in aiming. The national organizations allow only "open" sights in pistol and revolver shooting. "Peep" or "aperture" sights are barred. The rear sight usually consists of a notch shaped like a V or a U, the notch being as wide on top as at any part.



Side view. End view. Side view. End view.
Front Sights.

Rear sight. Appearance when aiming.
Military Sights.

Fig. 37.

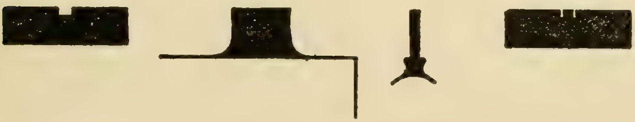
The front sight is a piece of thin metal set on edge. Sometimes the latter has a special shape or section resembling a pinhead when looking at it from the breech, as in aiming. Military sights usually consist of a plain notch in the top of the frame for the rear sight and a tapering front sight fixed to the barrel near the muzzle.

Target sights are made in endless variety to suit individual ideas. The sights most generally used for target-shooting are the "Paine" sights, named after Chevalier Ira Paine, who invented

Rear sight. Side view. End view. Appearance when aiming.
Front sight.
"Paine" Sights.
FIG. 38.

and was the first to use them. The rear sight is a flat bar with a semicircular notch, and the front sight is a "bead" sight; that is, a sight that resembles a pinhead when aiming.

Another sight that many of the best shots are using is the "Patridge" sight, developed by Mr.



Rear sight. Side view. End view. Appearance when aiming.
Front sight.
Patridge Sights.
FIG. 39.

E. E. Patridge of Boston, Mass. The rear sight has a wide rectangular notch; the front sight is plain with a square top, as shown.

These sights have been referred to in the order in which they are most used. It is generally necessary for individuals to try various sights before they are able to select intelligently. In target arms different-shaped sights may be used in the same base or fitting, so that it is a comparatively easy matter to try any or all of these sights on the same arm.

The notch of the rear sight should have a bevelled edge concave toward the front. This will secure sharpness of outline in any light. The front sight should also be distinct and is found to be most satisfactory when the side toward the eye is a surface at right angles to the line of sight.

Position

The position in pistol and revolver shooting is very important. In firing a long series of shots, a man with an easy, natural position will suffer much less fatigue, and will have a decided advantage over another whose position is straining and uncomfortable. Formerly the approved position was to stand with the right side toward the target. This required the head to be turned ninety degrees from its natural position, and was very

FIG. 40. — Walter Winans.

FIG. 41. — C. S. Axtell.

FIG. 42. — Thomas Anderton.

FIG. 43. — C. S. Richmond.

uncomfortable. Undoubtedly this position is a relic of duelling days, when it might have been argued that a smaller mark was offered to the antagonist.

The positions adopted by the leading shots vary considerably. Most of them face a trifle to the left of the target, with the right foot 6 or 8 inches ahead of the left, and pointing directly toward the target, the weight of the body supported equally by both legs and perfectly balanced. Others shoot with the feet close together; some with one or both eyes open, and with the arm partly or fully extended. The question of position depends largely upon the physique and comfort of the individual.

Mr. Winans' position is an exceedingly strong one. His poise is very good, and he stands firmly on both feet. The left arm falls straight down along the left side of the body. This affords rigidity when desired, and imparts action to the figure.

Mr. Axtell has a stanch, natural position. Like Mr. Winans, he shoots with the right arm fully extended, and he holds the weapon in the correct and most approved manner.

The position of Mr. Anderton is excellent. He

enjoys perfect health, and has his large muscular development well under control. His position is strong, natural, and comfortable. Another good position is that of Mr. Richmond. He is not as well poised as Mr. Anderton, but his position is graceful and businesslike.

The positions of Mr. Patridge and Sergeant Petty are characteristic and typical of persons of entirely different physique.

Mr. Gorman and Dr. Sayre are men of very similar physique. Their positions, which resemble each other closely, are firm, easy, and natural.

Target-shooting

In the development of firearms and ammunition, target-shooting has always occupied an important place. It is regularly and systematically practised in the army and navy, in order to maintain and improve the proficiency of the men as marksmen. Target-shooting, with many different styles of firearms, under prescribed rules and regulations, has also become extremely popular with civilians.

A target is a mark or object of suitable form and color designed to be fired at. It usually consists of a frame covered with canvas or paper,

Fig. 44. — E. E. Patridge.

Fig. 45. — Sergeant Wm. E. Petty.

FIG. 46. — J. E. Gorman.

FIG. 47. — R. H. Sayre.

presenting a white surface with a prominent spot or bull's-eye in the centre. Concentric circles around the centre divide the target into zones which are assigned values, decreasing from the centre outward. On a regularly equipped range the targets are movable frames, so arranged that they may be raised to the firing position and then lowered into a pit, where the marker can safely examine the target, mark the shot accurately, and cover the shot-hole with a paster. The sum of the values of a limited series of consecutive shots, as 5, 7, 10, 20, 50, etc., constitutes a score.

Target-shooting was indulged in extensively with the rifle many years before it became popular with the pistol and revolver. The shorter barrel, and the greater difficulty in acquiring skill with the latter weapons, were doubtless responsible for the mistaken idea long prevalent that these arms were extremely inaccurate. When, however, a few individuals developed sufficient skill to obtain fine shooting, their performances were considered phenomenal. Among the first to obtain a high order of skill with the muzzle-loading pistol in the United States was Captain John Travers of Missouri. He was well known as an expert pistol shot as early as 1860. In that year Cap-

tain Travers shot an interesting individual match in St. Louis at a distance of 100 feet. Fifteen china plates, nine inches in diameter, were used as targets. Captain Travers broke 11 out of the 15, while his opponent broke but 9.

In 1865 Colonel William F. Cody (Buffalo Bill) and Captain William P. Schaaf of St. Louis became prominent as pistol shots. The latter subsequently joined Captain Travers in a three years' tour of the United States, giving exhibitions in nearly all the large cities.

About 1880 Ira Anson Paine, a native of Massachusetts, attracted attention by his fine marksmanship with the pistol. In 1881 he went abroad, and for a number of years he travelled over the principal countries of Europe, giving public exhibitions of his skill with the pistol and revolver. While in Portugal in 1882 he was knighted by the king in the presence of a notable assemblage, and made a chevalier of an ancient military order. In his exhibitions Chevalier Paine used a Stevens Lord Model pistol and a Smith & Wesson revolver. His skill with these arms was so far in advance of his contemporaries that he was popularly supposed to accomplish many of his feats by trickery.

Target-shooting with the pistol and revolver, as a sport, may be said to have originated at the annual meeting of the National Rifle Association at Creedmoor in 1886. During that meeting a revolver match was scheduled to be shot at 25 yd. on the 200-yd. Standard American Rifle Target. It was a reëntry match, with the three best scores of five shots each of any contestant to count. In this match three scores of 48 out of 50 were made, the highest individual aggregate of three scores being 143 out of a possible 150.

The same year a similar match was announced at the fall meeting of the Massachusetts Rifle Association at Walnut Hill. Chevalier Paine was a competitor in this match, and made 50–49–49 = 148 in six entries. The next best three scores equalled 142.

These matches proved so interesting and successful that target-shooting with the pistol and revolver became instantly popular all over the country. It was soon found that the arms possessed remarkable accuracy, and as the skill of the shooters improved the distance was increased to 50 yd., retaining the same target.

Mr. A. C. Gould, editor of *The Rifle*, now *Shooting and Fishing*, was the first to recognize

the possibilities of the pistol and revolver, and became greatly interested in the performances with these arms. He assisted and encouraged the shooters, witnessed their work, and made careful and elaborate records of all the important scores that were made in the United States from 1886 to 1900.[1] It was at his suggestion that Chevalier Paine essayed to fire the first 100-shot score at 50 yd. on the Standard American Target, scoring 791 points. This shooting was done with a finely sighted .44 cal. Smith & Wesson Russian Model Revolver, regulation full charge ammunition, and a 2½ lb. trigger pull. A keen rivalry for the 100-shot record soon sprang up, resulting as follows: —

Oct. 15, 1886,	Chevalier Ira Paine at Walnut Hill	791
March 7, 1887,	Chevalier Ira Paine " " "	841
Nov. 4, 1887,	F. E. Bennett " " "	857
Nov. 14, 1887,	F. E. Bennett " " "	877
Dec. 5, 1887,	F. E. Bennett " " "	886
Dec. 17, 1887,	Chevalier Ira Paine " " "	888
Dec. 22, 1887,	Chevalier Ira Paine " " "	904
Dec. 23, 1887,	W. W. Bennett " " "	914

This rivalry led to a long newspaper controversy, and culminated in the famous Paine-Bennett revolver match. The conditions were

[1] See *The Modern American Pistol and Revolver*, by A. C. Gould. Bradlee Whidden, Publisher, Boston, Mass.

as follows: Stakes, $1000.00; 100 shots per day for six consecutive days; Smith & Wesson Russian Model Revolvers, .44 cal.; factory-loaded full charge ammunition; trigger pull, 3 lb.; Standard American Target with 8-in. bull's-eye; distance, 50 yd. On the fifth day of the match, and while 9 points in the lead, Chevalier Paine entered a protest and withdrew. Mr. F. E. Bennett continued shooting, as stipulated in the match, scoring 5093 points for the total of the six days. The protest was referred to the National Rifle Association, which decided in favor of Mr. Bennett, awarding him the match and the championship of America.

In practising for this match Mr. F. E. Bennett, under the same conditions, made a score of 915. This record was not excelled until June 1, 1901, when C. S. Richmond of Savannah, Georgia, scored 918 points under substantially the same conditions.

During the summer of 1890 Mr. William E. Carlin, assisted by Mr. Hubert Reynolds, made a very elaborate series of tests with the revolver and various kinds of ammunition. The shooting was done with a telescopic sight, and from a sandbag rest. The results obtained were remarkable,

and added materially to the definite information then available as to the capabilities of the revolver, the relative accuracy of different charges, etc.

A very interesting revolver match for a trophy offered by Mr. Walter Winans took place in 1892. Mr. Winans is a noted American revolver shot, residing in England, and the trophy — an American cowboy executed admirably in bronze — was modelled by him. The match was conducted by *Forest and Stream.* The trophy was won, after a spirited competition, by Dr. Louis Bell. Under the conditions of the match, the winner was to defend his title two years before the trophy became his property. The trophy was won successively by George E. Jantzer and Sergeant W. E. Petty. Sergeant Petty defended the trophy successfully for two years, and now holds it permanently.

The "best on record" performances with the single-shot pistol, on the Standard American Target, at 50 yd., are as follows: —

100 shots:

Sept. 22, 1888, F. E. Bennett, Walnut Hill, Mass.	906
Nov. 10, 1888, F. E. Bennett, " " "	934
Sept. 10, 1890, F. E. Bennett, " " "	936
Feb. 25, 1900, J. E. Gorman, San Francisco, Cal.	939
May 26, 1901, J. E. Gorman, " " "	942
March 1, 1902, E. E. Patridge, Walnut Hill, Mass.	942

50 shots:

Nov. 10, 1888, F. E. Bennett, Walnut Hill, Mass.	.	470
Feb. 11, 1900, J. E. Gorman, San Francisco, Cal.	.	471
May 20, 1901, J. E. Gorman, " " "	.	474
Dec. 7, 1901, T. Anderton, Walnut Hill, Mass. .	.	476
April 4, 1903, T. Anderton, " " " .	.	480

A record, or "best on record," is the highest recognized score of any given number of shots fired under certain standard conditions, and with an arm complying with certain established rules. The records of pistol and revolver shooting in the United States were carefully established and compiled by *Shooting and Fishing* until the year 1900, when the records were intrusted to the United States Revolver Association. This association, with the support and coöperation of all the leading shots of the country, formulated rules and regulations to govern pistol and revolver shooting, and inaugurated the annual championship matches. These are shot simultaneously in different parts of the United States, thus giving everybody an opportunity to enter the competitions. This association also negotiated and conducted the first international revolver match between France and the United States, which took place in June, 1900. This match attracted world-wide attention, and was won by the United

States. The conditions of the match were as follows: Ten men on a side; the Americans to shoot at Greenville, N.J., and the Frenchmen in Paris. Results to be cabled. Each side to appoint an umpire to witness the shooting of the opposing side. Each man to shoot 30 shots on the French target at 16 metres and 30 shots on the Standard American target at 50 yd. Possible, 6000. Total scores: Americans, 4889; French, 4828.

The influence of the association on pistol and revolver shooting has been very beneficial. It has established uniformity in arms, rules, etc., and has encouraged and conducted many friendly matches between clubs, thus bringing the shots in different parts of the country in closer touch with each other.

In order to become familiar with the arms and develop skill in shooting, careful and systematic practice is necessary. This can be most conveniently and intelligently obtained in target-shooting. At a properly equipped range, each shot is "spotted"[1] as fired, so that the shooter can tell instantly where each shot strikes. This is a great aid and

[1] The position of a shot accurately indicated by a marker from a pit or safe place near the target.

advantage, as it enables the shooter to note the effect of changes in light, wind, slight displacements in the sights, etc., and modify his work accordingly. The usual distance is 50 yd. Very good shooting has been done at 100 yd., and even at 200 yd., but such long-range shooting is rarely attempted except by the very best shots. The whole target being so small at that distance, a shot need not be very wild to miss the target. Such an occurrence is very unsatisfactory and disconcerting to a fairly skilful shot. There is, moreover, nothing to be gained by extremely long-range work. The pistol and revolver are not designed for it, and there is much more pleasure and satisfaction in shooting at the shorter ranges.

It is customary and desirable to practise at the target under the conditions governing the annual championship matches. This accustoms one to those conditions, and is a decided advantage if one expects to enter the competitions. It is also excellent training for record shooting. In target practice with military arms, regulation full-charge ammunition should be used in all cases, especially when practising rapid-fire shooting. With target weapons, reduced charges are frequently used, and the shooting is generally slow and deliberate.

The target used by the United States army for revolver practice is the regulation silhouette man target.

This consists of the figure of a man standing, and is used for both mounted and dismounted practice. For the mounted practice the target consists of a steel skeleton frame, covered with cloth and black paper, and is held in position by supporting rods and braces. This is designated as "Target D." Five of these targets are set up at a distance of 10 yd. and 20 yd. apart, and the troopers ride by them on the walk, trot, and gallop, firing one shot at each target as they pass. This practice is modified by changing the position of the targets so the position will be 25, 20, 15, 10, and 5 yd. respectively, and shooting to the right, left, and rear. Ten shots per man are also fired at "Target K"—the silhouette figure of a mounted soldier. The total ammunition allowance to cavalry troops for mounted and dismounted practice is 150 rounds per man annually.

For the dismounted practice, the silhouette figure of a man is mounted on a frame 4 ft. wide and 6 ft. high, and is known as "Target A-d." This target has a horizontal line through the middle. Hits in the black figure above the line count

5, and below the line, 4. Shots on the rest of the target above the line count 3, and below the line, 2. Five shots constitute a score. All revolver target practice consists of two classes, "preliminary" and "record," the latter being incorporated in the official reports. The artillery and infantry officers' practice consists of one preliminary score and two record scores at each of the distances, 10, 20, 30, 40, and 50 yd. For cavalry troops the prescribed practice on this target consists of one preliminary score at each of the distances, 10, 20, and 50 yd., and one record score at each of the distances, 20 and 50 yd.

Fig. 48.—Target A-d, U.S.A.

The United States army regulations also provide for annual competitions in each department, and in each even-numbered year a competition between representatives of all the departments. In the

competitions, the scores shot on the A-d target must be completed within certain specified time limits. After the competitor has taken his posi-

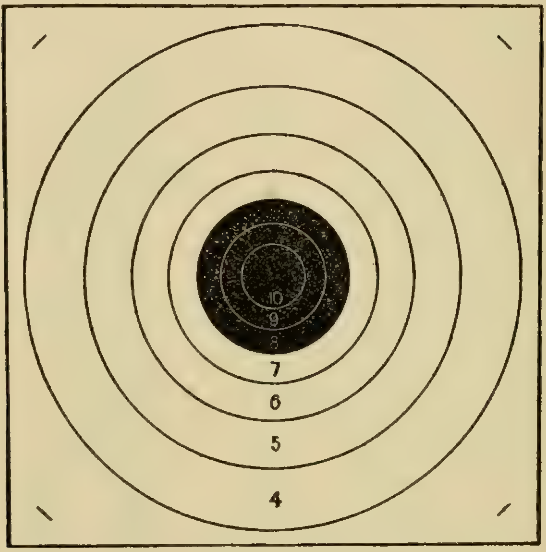


FIG. 49. — Standard American Target.

Diameter of Circles

10 circle	3.36 inches	Bull's-eye	6 circle	14.80 inches
9 "	5.54 "	Bull's-eye	5 "	19.68 "
8 "	8.00 "	Bull's-eye	4 "	26.00 "
7 "	11.00 "			

Rest of target, 28 × 28 inches.

tion at the firing point, revolver in hand, the range officer gives the commands "Ready," "Fire." At the command "Ready," the competitor raises his

pistol into the firing position, and begins to fire immediately after the command "Fire." The scores shot at 20 and 30 yd. must be completed within 11 sec., and the scores at 40 and 50 yd. within 12 sec. Gold, silver, and bronze medals are awarded to those making the highest scores.

The official target of the United States Revolver Association, which is used in the annual championship matches and for record shooting, is the Standard American Target. This target is also used by nearly all the shooting clubs and organizations in the United States. For 50-yd. shooting the bull's-eye is 8 in. in diameter and contains the 8, 9, and 10 rings. This target is well suited for target practice at this range. It has been used extensively since 1886. Ten shots, with one hundred for the possible, usually constitute a score. For gallery shooting at 20 yd. this target is reduced so that the bull's-eye is $2\frac{72}{100}$ in. in diameter, and for 10-yd. shooting 1 in. in diameter. In indoor shooting smokeless powder and reduced charges are always to be preferred. Where artificial ventilation is provided, some shooting may be done with black powder ammunition, but the range soon fills with smoke, rendering the targets indistinct and the atmosphere unpleasant. Gal-

lery practice is very valuable, as it enables one to preserve good form in the winter months, in localities where it is too cold to shoot with comfort and pleasure out-of-doors. An arm of large caliber has a decided advantage over one of small caliber in short-range shooting, on account of the larger hole made by the bullet, and, for this reason, the large calibers are preferred for gallery shooting. For distances less than 25 yd. not more than five shots should be fired on a paper or cardboard target. In case a close group is made, the scoring will be much easier and more accurate than when ten shots are fired at a single target. The best grades of target arms, including all those illustrated in this chapter, are capable of making "possibles" or perfect scores on the standard American target, using regulation ammunition. To make high scores is therefore simply a question of skill on the part of the shooter.

A great many other targets designed principally for rifle-shooting have been recommended at different times by well-known and scientific marksmen. Some of these targets possess much merit and have become popular in certain localities. It is unquestionably a mistake to introduce new targets in this manner as long as satisfactory

targets are in general use, and on which all the important matches and records have been shot. The merit of a score on a new target cannot be judged by those unfamiliar with it, and frequently a highly meritorious score fails to receive the recognition it deserves on account of having been shot on a comparatively unknown target.

In England and France the targets generally have smaller bull's-eyes than here. At Bisley, the shooting is principally at a distance of 20 yards on a bull's-eye 2 in. in diameter. At 50 yards the bull's-eye is 4 in. in diameter. The English targets have no circles of count within the bull's-eye. The regulation targets of the United Shooting Societies of France have bull's-eyes 5 and 6 centimetres in diameter for the pistol and revolver respectively, at 20 metres, and 20 centimetres in diameter for 50-metre shooting. All these targets have two or more circles of count within the bull's-eye.

ANNUAL CHAMPIONSHIP MATCHES OF THE UNITED STATES REVOLVER ASSOCIATION

Regular or Outdoor Events

Match A, Revolver Championship. — Open to everybody; distance, 50 yd.; 50 shots on the Standard American target, 8-in. bull's-eye, 10 ring 3.36 in. Arm, any revolver. Ammunition, any. The score must be completed in one hour or less from the time of firing the first shot. Entrance fee, $5; no reëntries.

Prizes: first, the championship silver cup, to be held until the next annual competition, and a gold medal; second, a silver medal; third, a bronze medal. A bronze medal will also be awarded to any competitor, not a prize winner, making a score of 425 or better.

Match B, Pistol Championship. — Open to everybody; distance, 50 yd.; 50 shots on same target as match A. Arm, any pistol. Ammunition, any. The score must be completed in one hour or less from the time of firing the first shot. Entrance fee, $5; no reëntries.

Prizes: first, the championship cup, to be held until the next annual competition, and a gold medal; second, a silver medal; third, a bronze medal. A bronze medal will also be awarded to any competitor, not a prize winner, making a score of 435 or better.

Match C, Military Championship. — Open to everybody; distance, 25, 50, and 75 yd.; five consecutive strings of five shots at each range on the same target as match A. Each string at each range must be shot within the time limit of 15 sec., taking time from the command "Fire." Misfires and shots lost on account of the arm becoming disabled while firing any string will be scored zero. If a shot is fired after the time limit has elapsed, the shot of highest count will be deducted from the score. No cleaning allowed. Arm, any military revolver, or any military magazine pistol. Ammunition, the full-charge service cartridge. The score must be begun at the shortest range, and must be completed on the same day. No sighting shots will be allowed after beginning the score. Entrance fee, $5; no reëntries.

Prizes: first, the championship trophy, to be held until the next annual competition, and a gold medal; second, a silver medal; third, a bronze medal. A bronze medal will also be awarded to any competitor, not a prize winner, making a score of 535 or better.

Match D, Military Record Match. — Open to everybody; distance, 50 yd.; five consecutive strings of five shots, under the same conditions as match C. Entrance fee, $1; entries unlimited.

Prizes: first, a gold trophy, to be held until the next annual competition, the trophy to become the property of the competitor winning it three times; second, a silver medal; third, a bronze medal. A bronze medal will also be awarded to any competitor, not a prize winner, making a score of 190 or better.

Indoor or Gallery Events[1]

Indoor Revolver Championship. — Open to everybody; distance, 20 yd.; 50 shots on the Standard American target reduced so that the 8

[1] These are conducted during the winter months.

ring is $2\frac{3}{4}$ inches in diameter. Arm, any revolver. Ammunition, any suitable smokeless gallery charge approved by the executive committee. The score must be completed in one hour or less from the time of firing the first shot. Entrance fee, $5 ; no reëntries.

Prizes: first, a silver cup, to be held until the next annual competition, the cup to become the property of the competitor winning it three times; second, a silver medal; third, a bronze medal. A bronze medal will also be awarded to any competitor, not a prize winner, making a score of 425 or better.

Indoor Pistol Championship. — Open to everybody; distance, 20 yd. 50 shots on the Standard American target reduced so the 8 ring is $2\frac{3}{4}$ in. in diameter. Arm, any pistol. Ammunition, any suitable smokeless gallery charge approved by the executive committee. The score must be completed in one hour or less from the time of firing the first shot. Entrance fee, $5 ; no reëntries.

Prizes: first, a silver cup, to be held until the next annual competition, the cup to become the property of the competitor winning it three times; second, a silver medal; third, a bronze medal. A bronze medal will also be awarded to any competitor, not a prize winner, making a score of 435 or better.

RULES AND REGULATIONS GOVERNING THE CHAMPIONSHIP MATCHES OF THE U. S. R. A.

1. *General Conditions.* — Competitors must make themselves acquainted with the rules and regulations of the Association, as the plea of ignorance will receive no consideration. The rulings and decisions of the executive committee are final in all cases. These rules are for general application, but will not apply in cases where the special conditions of any match conflict with them.

2. *Classification of Arms.* — (*a*) Any revolver. A revolver of any caliber. Maximum length of barrel, including cylinder, 10 in. Minimum trigger pull, $2\frac{1}{2}$ lb. Sights may be adjustable, but they must be strictly open in front of the hammer, and not over 10 in. apart.

(*b*) Any pistol. A pistol of any caliber. Maximum length of barrel, 10 inches. Minimum trigger pull, 2 lb. Sights may be adjustable, but they must be strictly open in front of the hammer, and not over 10 inches apart.

(*c*) Military revolver or pistol. A revolver, or a magazine pistol, that has been adopted by any civilized government for the armament of its army or navy. Maximum weight, $2\frac{3}{4}$ lb. Maximum length of barrel, $7\frac{1}{2}$ inches.

Minimum trigger pull, 4 lb. Fixed open sights. Rear sights of magazine pistols may be adjustable for elevation only.

(*d*) Pocket revolver. A revolver with a maximum weight of 2 lb. Maximum length of barrel, 4 in. Minimum trigger pull, 4 lb. Sights and model must be such as not to hinder quick drawing of the weapon from the pocket of holster.

3. *Loading, Firing, Timing, and Cleaning.* — In all revolver and pistol matches, the weapon must not be loaded until the competitor has taken his position at the firing point. The barrel must always be kept vertical or pointed toward the target. In case of an accidental discharge or of defective ammunition, if the bullet comes out of the barrel, it will be scored a shot. The timing in Matches C and D will be as follows: The competitor, standing at the firing point with the arm loaded, not cocked, and the barrel pointing downward in a direction not less than 45 degrees from the target, will signify to the scorer when he is ready to begin each string. The scorer, stop watch in hand, will then give the command "Fire," and exactly fifteen seconds later announce "Time." Misfires will not be scored except in Matches C and D. Competitors may clean weapons in Matches A and B, but no time allowance will be made for time spent in this way. All competitors will be required to finish their scores within the time limits specified, except in cases of accident, when the time may be extended at the option of the executive committee. Blowing through the barrel, to moisten it, will be considered cleaning.

In revolver matches, the arm cannot be used as a single loader or loaded so as to use a limited number of chambers in the cylinder. The cylinder must be charged with the full number of rounds for which it is chambered, and these must be shot consecutively. If scores are shot in ten-shot strings, the cylinder shall be charged first with six rounds and then with four rounds. If the cylinder only contains five chambers, then the ten-shot strings may be shot in two strings of five each. In Matches C and D, and in the indoor or gallery events, the arm shall in all cases be charged with five rounds.

4. *Position.* — The position shall be standing, free from any support, the pistol or revolver held in one hand, with arm extended, so as to be free from the body.

5. *Arms.* — Any revolver or any pistol which in the opinion of the executive committee complies with the conditions specified in Matches A and B will be allowed to compete in those events. Revolvers or magazine pistols that have been adopted by any government for the armament of its army or navy, or such as in the opinion of the executive committee are

suitable for military service, and which comply with the conditions specified in matches C and D, will be allowed in those events. Among the arms which may be used in this match are the .38-cal. Smith & Wesson and Colt Military; .44 Smith & Wesson, Russian Model; .44 Colt New Service; .45 Smith & Wesson Scofield; .45 Colt; and the following magazine or automatic pistols: Colt, Mannlicher, Mauser, Luger, Mors.

6. *Sights.* — In open sights, the notch of the rear sight must be as wide on top as at any part. Aperture or peep sights or any covered or shaded sights will not be allowed. The use of a notch for the front sight will not be permitted. Sights may be smoked or blackened if desired. Sights on military arms, if modified to suit individuals, must remain strictly open, strong and substantial, and suitable for military use.

7. *Trigger Pull.* — The trigger pull as specified in the various events shall be determined by a test weight equal to the minimum pull applied at a point three-eighths of an inch from the end of the trigger.

8. *Ammunition.* — In matches C and D, where full-charge ammunition is required, it may be the product of any reputable manufacturer. It must in all cases be brought to the firing point in unbroken boxes, with the label of the manufacturer intact.

9. *Targets.* — The 200-yd. Standard American rifle target No. 1 (containing the 4 ring) with an 8-in. bull's-eye shall be used in all matches at 50 yd., and at 25 yd. and 75 yd. in match C. The same target reduced so that the bull's-eye or 8 ring is 2¾ in. in diameter, shall be used for all matches at 20 yards.

10. *Marking and Scoring.* — In all matches new paper targets shall be furnished for each competitor. Not more than ten shots are to be fired on any target at 50 yd., and not more than five shots per target in matches C and D, and for all shooting at 20 yd.; the shot holes in all cases to remain uncovered and left as shot. Bullets touching or within a line on the target are to be scored the count of that line. The eye alone shall determine whether a bullet touches a line or not.

11. *Ties.* — Ties shall be decided as follows: (1) by the score at the longest distance; (2) by the score at the next longest distance; (3) by the fewest number of shots of lowest count; (4) by firing five shots each under the same conditions as the match and these rules in regard to ties, until decided.

12. *Records.* — The shooting for records shall, when practicable, be done on the grounds or in a gallery of a regularly organized shooting association or club, and in the presence of at least two witnesses, one of whom shall be an officer of the club. The foregoing rules and regulations, and

the conditions governing the championship matches of the U. S. R. A., must in all cases be observed and followed. The record score shall begin with the first shot after the shooter has announced his intention to shoot for record; only the first ten shots will apply to the ten-shot record; the first twenty shots to the twenty-shot record; and so on to fifty or one hundred shots, as the shooter may desire. After finishing the record score, the targets shall be identified and signed by the witnesses as above designated. The witnesses shall also prepare and sign a certificate of prescribed form, which, with all targets, shall be forwarded to the U. S. R. A., addressed to the secretary-treasurer. If all the conditions, rules, and regulations have been complied with, the scoring correct, and if the score is higher than or equal to any previously made under the same conditions, it will be declared a new record. The score will then be entered as such in the record book of the association, and the shooter formally notified to that effect.

13. *Protests.* — Any person who believes that an injustice has been done, or who dissents from the decision of any authorized executive officer of the association, may enter a protest on depositing $1 with the cashier or acting treasurer of the club or organization under whose auspices the matches are held. Such protest must be in writing, in duplicate, and must be made within twenty-four hours after the incident on which it is based; one copy to be handed to the executive officer of the club or organization conducting the matches, and the other copy to be mailed to the secretary-treasurer of the U. S. R. A. All protests will be investigated and passed upon by the executive committee; and, if sustained, the protest fee will be returned, otherwise it will be forfeited.

The following records, made on the Standard American target, are recognized by the U. S. R. A.: —

PISTOL, 50 YARDS

100 shots.	J. E. Gorman, May 26, 1901	942
	E. E. Patridge, March 1, 1902	942
50 shots.	Thomas Anderton, April 4, 1903	480
30 shots.	E. E. Patridge, March 21, 1903	287
20 shots.	E. E. Patridge, March 21, 1903	192
10 shots.	C. H. Taylor, November 8, 1898	100
	Thos. Anderton, May 13, 1899	100

REVOLVER, 50 YARDS

600 shots.	F. E. Bennett, June 4–9, 1888	5093
100 shots.	C. S. Richmond, June 1, 1901	918
10 shots.	W. C. Johnston, July 7, 1888	100

Revolver, 20 Yards

100 shots.	W. E. Petty, March 15, 1901	908
50 shots.	William H. Luckett, June 11, 1903	464
10 shots.	G. W. Waterhouse, March 22, 1901	98

Hints to Beginners

Selection of Arms. — There is no single arm that can be used advantageously for all classes of shooting. It is therefore necessary in the first place to decide for what purpose the arm is to be used. A careful perusal of the text under "Arms" and "Ammunition," will be of assistance in reaching a decision. The next step is the selection of the arm. As already stated, the cheap, unreliable, and unsafe arms are to be carefully avoided. It is preferable to buy a second-hand arm of a reputable manufacturer, if in good condition, than a new one of inferior make. Second-hand arms frequently have defects that cannot be detected by the novice, and, if obliged to buy a second-hand arm, it is advisable to ask some expert shot to assist in making the selection. The price of the best grades of pistols and revolvers is, fortunately, within the reach of almost every one, and, if at all possible, new arms should be purchased.

In any case, whether a new or a second-hand

arm is to be chosen, it is well to examine and handle all the different models of the best makers. The fit and feel of the arm are very important. Select an arm that feels comfortable, and which, when properly held, fits the hand so that the first joint of the trigger finger just touches the trigger when that part of the finger is bent at right angles to the barrel.

The correct manner of holding the pistol or revolver is here shown, and illustrates how the hand should fit the arm. Note particularly the position of the trigger finger and the thumb. The trigger finger in this position acts directly backward in pressing the trigger, and the thumb assists materially in steadying the piece. If the piece is too large for the hand, the trigger finger will be more or less extended, and will pull sidewise to a greater or less degree, and thus increase the difficulty of fine shooting. The fit of the arm is much more important, and has a vastly greater effect upon the results than fine distinctions between the merits of the different arms. Any of those named are excellent and are capable of shooting much more accurately than they can possibly be held by the most expert shots. A man with a large hand will probably find the Remington pistol

Fig. 50. — Correct Manner of holding the Revolver.

or the Colt New Service revolver best suited for him; another with a hand of medium size will find the S. & W. pistol or the S. & W. Russian Model revolver most desirable; while another still, with a small hand, may prefer the Stevens pistol or the .38-cal. military revolver, either the S. & W. or the Colt.

If an arm is wanted for steady use, select the plain blued finish, and wood handles; elaborate engraving and gold, silver, copper, or nickel finished arms are handsome and pleasing, but, if much used, become burnt and discolored where the powder gases escape, and soon become unsightly. A blued finish is also to be preferred when shooting in the sunlight. Most arms as offered on the market have hard rubber handles. These become smooth and slippery when the hand perspires, and are not as desirable as wood handles. A few expert shots prefer pearl handles.

The trigger pull should have the smallest possible travel and be smooth and positive. The smaller the travel of the hammer, the quicker will be the discharge after pulling the trigger. If the trigger does not pull smooth and "sweet," or becomes "creepy" from wear, it should be corrected by a skilled gunsmith. While the rules allow a

trigger pull of 2 lb. for the pistol and 2½ lb. for the target revolver, many expert shots prefer to have their arm pull from ½ to 1 lb. more. The rules also allow 7½ and 8 in. barrels for the revolver. Most of the experienced shots prefer to have their revolvers balance near the trigger, and are of the opinion that the extra length of barrel above 6½ in. does not offset the disadvantage of poorer balance. In the pistol, however, the length of barrel is invariably 10 in. Accuracy is lost very rapidly as the length of the barrel is reduced below 5 in.

For target-shooting, the .22-cal. pistols will be found admirably suited for beginners. The charge being light, there is less liability to "flinch," a fault easily and almost invariably acquired when the novice begins shooting with a heavy charge. The practice in aiming and pulling the trigger with these arms is excellent training and a first-rate and valuable preliminary to the more difficult and practical work with the revolver.

The double-action feature in a revolver is of very little practical value. Owing to the varying amount of resistance to the trigger in operating the mechanism, the aim is disturbed more than if

the hammer is cocked with the thumb. Even in rapid-fire shooting better results are obtained with a double-action arm if used as a single action. It is also more difficult to make the trigger pull smooth and short in double-action mechanisms.

Manipulation. — Most of the accidents with firearms are caused by carelessness and ignorance in manipulating them. The revolver and pistol, being much smaller, are more dangerous to handle than the rifle or the shotgun. An experienced pistol shot can easily be singled out by the extreme care and unostentation with which he handles his arms.

On picking up an arm, or if one is handed to you, open the action at once and make sure it is not loaded. *Always* do this, even if it is your own arm and you are quite sure it was not loaded when you last put it away; some one, without any idea of the danger, may have loaded it in your absence. Cultivate and practise the habit of always holding the arm, whether loaded or unloaded, so that it points in a direction where it would do no harm if it were to go off unexpectedly. By observing these simple rules, serious accidents will be impossible. No one should be allowed to handle firearms in a shooting club or

participate in any of the public matches until these rules have been thoroughly mastered.

Position and Aiming. — If you know of a club or shooting organization to which one or more first-rate pistol and revolver shots belong, it is well to join it, if possible. Much more rapid progress can be made by observation and by following the suggestions of experienced shots than if one is obliged to solve the various problems without such assistance or advice. In order to familiarize yourself with your arm, it is well to practise aiming and pulling the trigger before any actual shooting is attempted. By inserting an empty shell for the hammer to strike upon, the piece may be aimed and "snapped" without injury. The position you adopt is very important. Stand firmly on both feet, with the body perfectly balanced and turned at such an angle as is most comfortable when the arm is extended toward the target in aiming. Let the left arm assume any position that may be comfortable and natural. Select a small black spot with an extensive white background to sight at. A small black paster on a window-pane, with the sky for a background, is excellent for this purpose. When the aiming is correct, that is, when the sights are properly

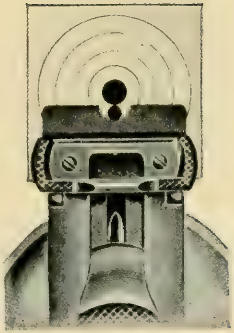


Fig. 51. — Correct position of the sights in aiming at the target.

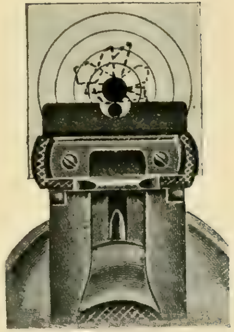


Fig. 52. — Showing the travel of the line of the sights about the bull's-eye in aiming.

aligned, their position with reference to the spot or bull's-eye should be as shown in Fig. 51. The top of the front sight should just make contact with the lower edge of the bull's-eye corresponding to the position of VI o'clock. It has been found by experience that it is much less fatiguing to lower the arm, holding the piece, to the target than to raise it, fully extended, up to the target.

With the pistol or revolver in the right hand, cock the hammer with the thumb, making sure that the trigger finger is free from the trigger and resting against the forward inner surface of the trigger guard. In cocking the piece, have the barrel pointing upward. Then extend the arm upward and forward, so that when you assume your firing position the piece will point about twenty degrees above the bull's-eye. With your eyes fixed on the bull's-eye at VI o'clock, inhale enough air fully but comfortably to fill the lungs, and lower the piece gradually until the line of the sights comes a short distance below the bull's-eye. Now, holding your breath and steadying the piece as well as you possibly can, bring the line of the sights into the position shown in Fig. 51. At the same time gradually increase the pressure on the trigger directly backward, so that

when the sights are pointing at the bull's-eye the hammer will fall. Be careful not to pull the trigger with a jerk, but ease it off with a gentle squeeze, so as not to disturb the aim. Accustom yourself not to close the eye when the hammer falls, but note carefully where the line of the sights actually points at the instant that the hammer falls. You will, no doubt, find it almost impossible to pull the trigger at the moment the sights are just right. The hammer will fall when the line of the sights may point a little too high or too low, or to one side or the other of the bull's-eye; but patient practice will correct this, and in time you will be able to let off the arm at the right moment.

The pulling of the trigger is a very delicate operation; it is, in fact, the most important detail to master — the secret of pistol and revolver shooting. If the trigger is pulled suddenly, in the usual way, at the instant when the sights appear to be properly aligned, the aim is so seriously disturbed that a wild shot will result. To avoid this, the pressure on the trigger must always be steadily applied, and while the sights are in line with the bull's-eye. It is, of course, impossible to hold the arm absolutely still, and aim

steadily at one point while the pressure is being applied to the trigger; but, in aiming, the unsteadiness of the shooter will cause the line of the sights to point above the bull's-eye, then below it, to one side of it, and then to the other, back and forth and around it, as shown by the dotted lines in Fig. 52. Each time that the line of the sights passes over the bull's-eye the smallest possible increment of additional pressure is successively applied to the trigger until the piece is finally discharged at one of the moments that the sights are in correct alignment. Long and regular practice alone will secure the necessary training of the senses and muscles to act in sufficient harmony to enable one to pull the trigger in this way at the right moment for a long series of shots. A "fine sympathy" must be established between the hand, the eye, and the brain, rendering them capable of instant coöperation. The consciousness of the voluntary concurrence of the mind and the muscular system constitutes the real charm of pistol and revolver shooting.

After obtaining a fair idea of aiming, etc., watch carefully when the hammer falls, and note if it jars the piece and disturbs the aim. If not, you are holding the arm properly. If the aim is

disturbed, you must grip the arm tighter or more loosely, or move your hand up or down on the handle, or otherwise change your method of holding the piece until your "hold" is such that you can snap the hammer and the aim remain undisturbed. This aiming drill is largely practised by expert shots indoors, when they do not have the opportunity to practise regularly out of doors.

Target Practice.— If your first actual shooting is done at the range of a club, it is best to ask one of the members to coach you until you get accustomed to the rules, etc. A target will be assigned to you, and you will repair to the firing point and load your arm. It is well to let your coach fire the first shot or two, to see if your piece is sighted approximately right. If so, you are ready to begin shooting. If the sights appear to be as in Fig. 51 at the moment of discharge, then the bullet should hit the centre of the bull's-eye. If, after several shots, you are convinced that the bullet does not strike where it should, the arm is not properly sighted for you. In adjusting the sights, you will find it an advantage to remember a very simple rule: To correct the rear sight, move it in the same direction as you would the shots on the target to correct them; or

move the front sight in the opposite direction. Most target arms have the front sight non-adjustable, and the rear sight adjustable for both windage and elevation. A few arms have interchangeable or adjustable front sights for elevation. Move the sights a little at a time, according to the foregoing rules, until they are properly aligned. A few ten-shot scores should then be fired for record. As you become accustomed to the range, rules, etc., you will feel more at ease. This will inspire confidence, and your shooting will improve correspondingly. Do not have your sights too fine. Fine sights are much more straining on the eyes, and have no advantage over moderately coarse sights. The rear sights, as generally furnished, are purposely made with very small notches, so as to enable individuals to make them any desired size. It is well to have the trigger pull at least $\frac{1}{4}$ of a pound greater than the minimum allowed by the rules. If much used, the pull sometimes wears lighter; and if there is little or no margin, you run the risk of having your arm disqualified when you wish to enter an important match.

Never use other ammunition in your arm than that for which it is chambered. A number of

accidents and much difficulty have resulted from using wrong ammunition. In the same caliber the actual diameter of the bullets frequently varies considerably, and a few shots, even if they should not prove dangerous, may lead the barrel, and thus cause much delay and annoyance. When a barrel is "leaded" from any cause it will become inaccurate. In such cases, particles of lead usually adhere to the inside of the barrel at or near the breech. A brass wire brush, of suitable size to fit the barrel, will generally remove it. When this fails, the safest treatment is to cork up the opposite end of the barrel and fill it with mercury, letting the latter remain in the barrel until the lead is removed.

Occasionally the powder is accidentally omitted in loading a cartridge. When the primer explodes, the bullet may be driven partly through the barrel and remain in it. When this happens, whether from this cause or any other, always be careful to push the bullet out of the barrel before firing another shot. If the bullet is not removed, and another shot is fired, the barrel will be bulged and ruined. This may occur with a light gallery charge.

When shooting the .22-cal. long rifle cartridge,

there will be an occasional misfire. In withdrawing the cartridge the bullet will stick in the barrel and the powder spill into the action. To prevent this, hold the barrel vertically, with the muzzle up, and withdraw the shell carefully. Then remove the bullet in the barrel with a cleaning rod; or extract the bullet from a new cartridge, inserting the shell filled with powder into the chamber back of the bullet and fire it in the usual manner. Do not use BB caps in any pistol that you value. They are loaded with fulminate of mercury and the bullets have no lubrication. These caps will ruin a barrel in a very short time. The .22-cal. conical ball caps contain powder, and the bullets are lubricated, making this a much better cartridge; but it is best to adhere to the regular .22 ammunition for which the arm is chambered.

In practising rapid-fire shooting, great care is necessary in order to prevent accidents, especially in the case of the automatic pistols, which remain cocked and ready to pull the trigger after each shot. In shooting within a time limit, practise to use the entire period allowed and endeavor to do the best possible work, getting in the last shot just before the end of the period.

It is also necessary to exercise extreme care in practising with the pocket revolver. Some persons delight in practising quick drawing from the pocket and firing one or more shots. This is dangerous work for the novice to attempt. Most of the pocket weapons are double action. If the finger gets into the trigger guard and the arm catches in the pocket when drawing, a premature discharge is likely to result, which is always unpleasant and sometimes disastrous. Practice in drawing the revolver from the pocket or holster should always be begun with the arm unloaded. Only after a fair degree of skill is acquired should actual shooting be attempted. For quick drawing from the pocket the only double-action revolvers that are fairly safe to handle are the S. & W. Safety Hammerless, and the Colt "Double Action," which has a safety notch for the hammer to rest on.

Drawing a revolver from a holster is easier and much less dangerous than drawing it from the pocket. Larger and more practical arms are generally carried in holsters, and such arms should be single action in all cases. In practising with a holster weapon, fasten the holster on the belt, and anchor the belt so that the holster will always be

at the same relative position. The holster should be cut out so that the forefinger can be placed on the trigger in drawing. Always carry a loaded arm with the hammer resting on an empty chamber or between two cartridges. In the woods, or in localities where such shooting would not be likely to do any harm, it is good practice to shoot at a block of wood drifting down in the current of a swift-flowing stream, at a block of wood or a tin can swinging like a pendulum, from horseback at stationary and moving objects, and from a moving boat at similar objects. Such practice is largely indulged in by cowboys, ranchmen, and others in the western part of the United States. Many of the published reports of wonderful shooting of this character are gross exaggerations. Such shooting is generally rapid-fire work with heavy charges at extremely short range, and while it is to be commended as being extremely practical, the actual performances do not compare favorably with similar work done by many amateur shots.

In shooting a long series of shots with black powder ammunition, when the rules allow it, the barrel should be cleaned and examined every six or ten shots, depending upon the clean-shooting

qualities of the ammunition used. It is well to examine the shells, also, and note if the primers have been struck in the centre. If not, then some of the mechanism is out of line, and the parts likely to have caused the trouble must be cleaned.

After securing good, reliable arms, stick to them. Much time and progress is frequently lost by buying and trying different arms, ammunition, etc. If, in any of your shooting, you should get results that are peculiar and unsatisfactory, make it your business to find out the cause of the difficulty, and remedy it as soon as possible. "Blazing away" a large quantity of ammunition carelessly and recklessly is absolutely valueless as practice, and is a waste of time. Give your whole attention to your work, and try your very best to place every shot in the centre of the bull's-eye. It is important to keep a full, detailed record of all your shooting, for comparison, study, etc. A suitable book should be provided for this purpose. Do not fall into the habit of preserving only a few of the best scores; but make it a rule to keep a record of *every shot*, and figure out the average of each day's work. The more painstaking and systematic you are, the more rapid will be your

progress. By careful, intelligent work, it is possible to become a fair shot in three or four months, and a first-rate shot in a year.

After a number of good shots have been developed in any club, there is generally a desire to measure skill with the members of another club. This leads to friendly matches, which are usually very enjoyable and instructive. Shooting in a match places a man under a certain strain which affects individuals quite differently; some become nervous and shoot poorly when the best work is expected of them, while others are braced up by the occasion and shoot brilliantly.

Cleaning and Care of Arms. — To maintain the highest efficiency in an arm, it is necessary to keep it in perfect order. The working parts must be kept clean and oiled, and the barrel should receive special attention and care. The residue of some powders is less injurious than that of others, but the arm should in all cases be cleaned and oiled immediately after it has been used. The cleaning should be very thorough. Heavy new cotton flannel is excellent for this purpose. It should be perfectly dry. Much of the fouling will rub off without moisture, but if moisture is necessary to soften the fouling in

places, use a thin oil. Never use water, kerosene, benzine, or similar fluids. For certain kinds of smokeless powders, cleaning fluids have been prepared that give good results. Be careful to use the special fluid that is adapted to the particular powder used, as the wrong fluid may do harm. For cleaning the inside of a barrel a wooden rod is best. It should have a knob on the end of such size that one or two thicknesses of the cotton flannel around it will fit the bore snug and tight. Square patches of suitable size may then be cut in quantities and used as required. Clean from the breech end of the barrel whenever possible. The slightest burr or injury at the muzzle will spoil the accuracy of an otherwise good barrel. Particular care should be exercised, especially if a steel rod with a slot is used, to prevent the wad from "jamming" in the barrel. Continue cleaning the inside of the barrel until tight-fitting patches, when withdrawn, show no discoloration, and the barrel is warm from the friction of the cleaning. Then saturate a fresh patch with good oil and pass it through the barrel several times, making sure that the entire surface of the grooves has been thoroughly coated with oil. After the cylinder and other parts are cleaned, they should

also be oiled. A good oil for cleaning and preventing rust is "Three in One," or refined sperm oil. Plenty of oil should be kept on the circle of teeth in which the hand engages in revolving the cylinder. If smokeless ammunition is used, the oil should be removed from the interior of the barrel and the chambers of the cylinder, a day or two after the first cleaning, and fresh oil applied.

In warm weather, when the air is humid, arms rust very quickly. If they are not kept in an air-tight compartment, they should be inspected, and, if necessary, oiled every few days. Under ordinary conditions, a thorough cleaning and oiling will preserve the arm in good condition for a month. If it is desired to store the arms, or protect them for long periods of time, the interior surfaces of the frame, and all the mechanism, should be carefully cleaned and oiled, and then the entire space within the frame filled solid with a non-liquid grease, like the Winchester "gun grease." After cleaning the barrel and cylinder, the bore and chambers in the cylinder should also be filled solid with the grease. This treatment excludes the air, and absolutely prevents oxidation. The exterior should be oiled, and then coated heavily with "gun grease." Place the arm

in a dry woollen cloth, or flannel cover, and wrap it up in a double thickness of new manila paper of the weight of ordinary writing paper. Repeat this, wrapping twice more, each wrapping independent of the other. Then lay the arm in a dry place, where the temperature will always be uniform, and not so warm as to melt the grease. An arm protected in this way will remain in good condition for a period of two years.

Reloading Ammunition

The factory-loaded ammunition for pistols and revolvers is so excellent that little is to be gained by hand loading. It is sometimes desirable, however, to use special loads that are not furnished by the factories, and such ammunition must be loaded by hand. Then, too, many persons prefer to reload ammunition for economical reasons. In order to do this successfully, considerable experience and skill are necessary. The first attempts at reloading are invariably unsatisfactory and disappointing, and sometimes result disastrously. Extreme care and close attention to details are absolutely essential, especially if smokeless powders are used. It is much the safest and best plan for those who are unfamiliar with reloading

to observe and study the methods used by skilled persons, and, if possible, have their first work supervised by an expert.

Primers. — The primers are made of copper and brass and are adapted for either black or smokeless powders. The primers for pistol and revolver cartridges are made more sensitive than for rifle cartridges. If, by mistake, rifle-cartridge primers are used, there are likely to be many mis-fires. The original pasteboard boxes in which the cartridges or shells are purchased invariably have labels designating the kind of primer that should be used in reloading them. The quality of the primers affects the results to a much greater degree than most persons imagine, especially in reduced or gallery charges. In handling or in transportation the fulminate is sometimes loosened, dropping out of some of the primers and leaving them considerably weaker than the rest. On opening a new box, empty it carefully, and if any appreciable quantity of loose fulminate is found, the primers should not be used for ammunition intended for fine shooting.

Shells. — The shells are generally made of brass with a solid head containing a pocket for a primer. There is considerable variation in the thickness

of the metal from which shells are made by the various manufacturers. Since the outside dimensions must be the same in order to fit the chamber, it follows that the inside diameter of the shells will vary. When the shell is to be crimped a slight difference in the size is unimportant, but for fine target work and in reduced charges it is preferable not to crimp the shell. In the latter case the bullet must fit sufficiently tight so that it will not be dislodged by the recoil of the arm. The size of the bore, when adapted to the same cartridge, varies a trifle, also, with different manufacturers. With the slight difference in the size of the shells it is therefore generally possible to select a make of shell the size of which will be just right to hold snugly in position by friction a bullet that exactly fits the bore of the arm. These refinements in the fit of the bullet and shell are important in securing good results with reduced loads. In pistol and revolver shooting, the shells may be reloaded many times with smokeless powders. The small charge and the consequent reduced pressure do not seem to render the shells brittle and unsuitable for reloading, as is the case with the shells of many of the high-pressure rifle cartridges.

Bullets. — In the large ammunition factories

the bullets are made by the swaging process with heavy machinery. They are, in consequence, very uniform in density and size. For this reason, when the ammunition is intended for fine shooting, factory bullets should be used. They are packed in boxes of twenty-five and fifty and are lubricated ready for use. While very few persons are able to mould bullets as good as those factory-made, when bullets of a particular shape, weight, or temper are desired, they must be moulded. The Ideal Manufacturing Company's dipper and melting pot[1] are useful for this purpose. The best quality of lead in bars or pigs should be used. If the bullets are to be hardened, "block tin," which may be had at any hardware store, is alloyed with the lead. Weigh the proper quantity of each metal to give the desired proportions. Melt the lead in the pot over a steady fire and then add the tin. After both are melted immerse the dipper and allow it to acquire the temperature of the melted lead. Then fill the dipper and, with the nozzle horizontal, raise it two or three inches above the surface of the lead in the pot.

[1] The Ideal Manufacturing Company of New Haven, Conn., publishes a handbook containing full information in regard to moulding bullets, reloading ammunition, tables, and other useful information relating to shooting.

With the mould in the other hand, turn it sidewise and bring the pouring hole of the mould to the nozzle of the dipper. Then, with the mould and dipper in contact, tilt or turn both in this position until the dipper is over the mould and the nozzle vertical as shown.

The weight or pressure of the lead in the dipper is thus utilized to force the lead into and

FIG. 53.— Moulding Bullets.

completely fill the corners of the mould. It will be necessary to mould forty or fifty bullets before the mould acquires the proper temperature and casts first-class bullets. All imperfect bullets should be thrown back into the melting-pot. Experience has shown that the best results are obtained when the lead and mould are such a temperature that two or three seconds elapse before the lead solidi-

fies in the pouring hole after the nozzle has been removed from it. Do not allow the lead to get red-hot, as it oxidizes very rapidly and more dross forms on its surface at that temperature. The dross should be skimmed off and not allowed to collect in the dipper. A new mould will not cast perfect bullets until the surfaces in contact with the lead are free from oil and have become oxidized, assuming a deep blue color. Provide a soft surface for the bullets to fall upon after releasing them from the mould, as they are easily deformed while hot. The sliding top or "cut-off" should be operated by pressing down the lever end on a board or table, or striking the lever with a small wooden mallet. The mould is then opened, and the bullet drops out. If the bullet sticks in the mould, strike the empty half of the mould on the outside, directing the blow toward the bullet. This will jar the bullet out of the mould without difficulty. Never strike the mould with a hammer or any hard substance, and never attempt to pry a bullet out of the mould or touch the interior surface with anything that will mar it. The least indentation of the sharp edges of the mould will cause the bullets to stick and make them imperfect. After using, oil the interior and exterior

surfaces and joints while warm, wrap in a dry cloth, and keep in a dry place where it will not rust. The safest way is to fill the inside of the mould solid with "gun grease" after it has cooled.

The fit of the bullets is very important. Nearly all the bullets for revolver cartridges have been designed to be used with black powder. Many of them are slightly under size and have concave bases which upset sufficiently, on the ignition of the regulation powder charge, to fill the grooves of the barrel. Reduced charges of black powder, and smokeless powders, even in full charges, seldom upset the bases of these bullets, and the powder gas escapes around the sides of the bullet, which is known as "gas cutting." This is fatal to accuracy. For smokeless powders and reduced loads the concave cavity at the base of the bullet must be large enough to reduce the thickness of the outer rim of the bullet and weaken it so it will be expanded sufficiently by the powder to fill the grooves of the barrel; or the diameter of the bullet should be increased so as to produce the same effect. A simple test to determine the fit of the bullet is to force it into a clean barrel, and then hold the barrel in the

direction of a window or bright light. If light can be seen in any of the grooves around the bullet, it is too small for smokeless powder. The remedy is to have the bullet mould reamed out and enlarged so the bullets will be the proper size. To determine the actual diameter of the bore of a pistol or revolver, oil the inside of the barrel liberally and then force a bullet into it a couple of inches. With a short wooden cleaning rod, hold the bullet in that position while you drive against it with another rod from the opposite direction, swaging it so as to fill the barrel. This must be done gently and carefully so as not to strain or injure the barrel. The bullet is then driven out and carefully measured with a micrometer gauge. Many who mould their own bullets prefer to order the mould to cast the bullets the exact size to fit the barrel; while others prefer to have the mould cast the bullet one or two thousandths of an inch too large, and then pass them through a sizing tool, reducing them to the correct size. The latter method insures absolute uniformity. For smokeless powders the bullets are generally cast a little harder than for black powder, the proportions being from 20 to 1, to 12 to 1, of lead and tin respectively. To secure

good results, the bullets should not vary more than $\frac{1}{200}$ in weight.

The next operation after moulding the bullets is to lubricate them. A good lubricant may be prepared by melting together $1\frac{1}{2}$ lb. of Japan wax, 1 lb. of mutton tallow, and 1 lb. of vaseline. The bullets should be set in a shallow pan, bases down, and with a small space separating them. The lubricant can then be poured around them until it rises high enough to fill the top cannelure. After cooling, the bullets are cut out of the lubricant by forcing them into the mouth of a specially prepared shell with the top or head cut off. Each bullet is picked up in this way and then pushed out with a round stick. Any lubricant on the base of the bullet should be removed with a cloth before loading. An excellent machine for lubricating bullets is made by the Ideal Manufacturing Company. The machine sizes and lubricates the bullet at one operation. It is rapid, clean, and performs the work perfectly.

Powders. — American powder manufacturers have no uniform practice in regard to designating the different grades of powder, sizes of grains, etc. The powders that give the best results under certain conditions must therefore be classi-

fied. The following black powders are best suited for ammunition in which the charge is ten to twenty grains: —

American Powder Mills Rifle Cartridge No. 4.

Hazard Powder Company's "Kentucky Rifle F F G."

E. I. Dupont de Nemours & Company's "Dupont Rifle F F G."

Laflin & Rand Powder Company's "Orange Rifle Extra F F G."

King Powder Company's "Semi-smokeless F F G."

When the charge is less than ten grains in weight, one size finer grain of the above powders should be used; and for charges heavier than twenty grains, one size coarser grain will give the best results.

For reduced or gallery charges, the high-grade quick-burning shotgun powders are sometimes used, such as "Hazard's Electric," "Dupont's Diamond Grain," etc. These powders should not be used in full charges, and if compressed in the shell will give very irregular shooting.

Smokeless powder differs from black not only in composition, but also in the phenomena that attend combustion. Special conditions are there-

fore created which have an important bearing on the results. Smokeless powders are divided into two general classes, designated as "bulk" and "dense," the former having approximately the same strength as an equal bulk of black powder, while the same quantity by bulk of the latter may have from five to ten times the strength of black powder. The bulk powders may be used very much the same as black powder, except that they should never be compressed. No air space is required between the powder and the bullet. Dupont's Smokeless Rifle Powder No. 2 and Hazard's Smokeless Rifle Powder No. 2 are good examples of the bulk powders.

The dense powders, such as Laflin & Rand Smokeless, Walsrode, Ballastite, and others, on account of their concentrated form, must be manipulated with great care and precision. The same quantity by bulk as black powder of any of these would in many cases cause disaster. Special shells with an annular crease, which only admits the bullet a certain distance into the mouth of the shell, and providing an air space, must in all cases be used with these powders. Some varieties of smokeless powders, like Walsrode, require a certain amount of confinement in order to secure

complete combustion, and do not give good results unless the shell is crimped securely to the bullet. A table giving the proper charges is supplied by all the manufacturers of smokeless powders, suitable for revolver and pistol shooting. These charges should in no case be increased. If it is desired to adapt a smokeless charge to a special bullet, which gives good results with black powder, the approximate equivalent in smokeless can easily be calculated from the powder company's table of charges. If the calculated charge does not give good results, compare the penetration of the smokeless charge with the black powder charge, and modify the former until it gives approximately the same penetration as the latter. If this does not correct the difficulty, the fit of the bullet should be investigated, and possibly it may have to be increased in size slightly and hardened before the best results will be obtained.

No attempt should be made to secure higher velocities or greater penetration with the ordinary lead bullet than is obtained with black powder. Such results can only be produced with hard alloy or jacketed bullets, special rifling, etc., and in arms designed to withstand the severe conditions incident to such augmented effects. Exces-

sive charges in regulation arms, besides being extremely dangerous, are likely to cause the bullet to strip the rifling and lead the barrel.

Reloading. — Suitable tools for reloading are furnished by the Ideal Manufacturing Company, Smith & Wesson, and the Winchester Repeating Arms Company. These usually consist of one or more combination tools, with which the various operations of reloading may be performed with rapidity and precision. In reloading ammunition the one thing to be borne in mind above all else is *uniformity*. No matter how excellent may be the quality of the powder, or how perfect the bullets, if there is any variation in quantity, size, etc., the results will surely be irregular and disappointing. The bullets should be of the same diameter and weight, the mouth of the shells of uniform size, the powder accurately measured, and all the details in the operation of loading each shell should be as nearly identical as it is possible to make them.

The primers should be extracted from the shells as soon as practicable after firing. The shells should then be immersed in hot soap-suds and stirred around briskly until thoroughly washed. If it is desired to brighten them, or to remove corrosion, add one tablespoon of sulphuric

acid to each quart of suds. Rinse the shells in two clean, boiling waters, by agitating them as before, and then dry them by exposure to sunlight or mild heat. Intense heat will draw the temper of the shells and ruin them. When the shells are perfectly dry, insert a stiff bristle brush in each and loosen any foreign matter that may adhere to them. Remove this by inverting the shell and tapping it. The sooner the shells are cleaned after firing, the less will be the corrosion and the easier it will be to remove the residue of the powder. The life of the shells will also be greatly prolonged if properly and promptly cared for. If the shells were originally crimped, they will have to be opened with the tool so as to admit the bullet without abrading its surface. The primers may now be replaced. In doing this, be sure to seat them firmly on the bottom of the socket and below the surface of the head of the shell. This will prevent misfires and premature explosions.

The measuring of the powder charge is the most important detail in reloading ammunition. There are several devices to measure black powder that are convenient and accurate. Those furnished by the Ideal Manufacturing Company

and H. M. Pope are the best. The usual method is to measure the powder with a "charge cup" that is supplied with the reloading tools. A quantity of powder should be poured from the can into a small box, and the charge cup dipped into it and filled. With a lead-pencil, tap the cup lightly two or three times on the side to settle the powder uniformly. If the powder settles below the top of the cup, dip it into the powder again and fill it, being careful not to tilt the cup so as to disturb the powder already in it. Strike off the surplus powder, level with the top of the cup, and pour it into the shell. By measuring the powder in this way, and verifying it by weighing each charge in a delicate balance, a high degree of skill is acquired in a short time. Ordinary revolver charges should not vary more than $\frac{1}{5}$ of a grain in weight. The charge cup method is preferred in measuring smokeless powders, as some varieties, being coarse-grained and light in weight, are liable to form large voids. Such voids are invariably corrected when the charge cup is tapped and the powder settles.

After the desired quantity of shells has been primed and charged with powder, the bullets, properly lubricated, are started into the shells by

hand, and then one by one the cartridges are placed in the reloading tool, which seats the bullet and crimps the shell.

In reduced charges, when the bullet is seated below the mouth of the shell, the tool should be adjusted so as not to crimp the shell. The black powder gallery loads as given under "Ammunition" are entirely satisfactory, and are fairly accurate up to distances of 20 yd. Fired from a $6\frac{1}{2}$-in. barrel, they will generally shoot within a $1\frac{1}{2}$-in. circle at that distance. In loading cartridges in which the shells are not crimped on the bullets, it is very important that both the shells and bullets should be absolutely uniform in size, so that the fit of the bullet in the shells will be the same in all cases. By reloading some of the shells oftener than others, or with different charges, the expansion of the shells will vary, and the bullets will fit more or less tightly. Such ammunition, when fired, will vary in elevation. It is well to begin with new shells, using the same load in them and reloading them the same number of times. Even with the same charge and under apparently identical conditions, a few of the shells will expand differently. This variation will, however, be readily discovered in seating the bullets

with the tool. Cartridges in which the bullets seat with greater or less effort than the average, should be carefully separated from the rest and not used in important matches or when fine shooting is required.

In reloading ammunition with round bullets, the neck of the bullet should be down, facing the powder. The bullets should be about $\frac{1}{1000}$ of an inch larger in diameter than the grooves of the barrel, so that when seated in the shells they deform slightly on the circle of contact. This produces a narrow cylindrical surface around the bullet, affording a better bearing on the barrel and greatly increasing the accuracy. It also insures the tight fitting of the bullet, preventing it from being displaced by the recoil. If round bullets fit loosely in the shell or barrel, or if there is the slightest imperfection in the bullet where it comes in contact with the shell, "gas cutting" will result, and hot lubricant is liable to pass by the bullet into the powder charge. In either case the accuracy is destroyed.

When round bullets are used, the lubrication is applied after they have been seated in the shell. This can best be done with a small brush. The brush is dipped into melted lubricant and then

passed around the bullet where it is in contact with the shell. Too much lubricant is undesirable. At least two-thirds of the surface of the bullet should project above the lubricant. By keeping the lubricant at a constant temperature, the quantity adhering to the brush will be the same, and the result uniform.

THE ARTIFICIAL FLY

FOR TROUT, SALMON, AND BASS

ITS THEORY, MAKING, AND USE

BY JOHN HARRINGTON KEENE

THE ARTIFICIAL FLY

The Theory of the Trout Fly

The artificial fly is *per se* palpably the "counterfeit presentment" of the natural insect or fly. Conceding that the most perfect "artificial" is only an attempt at an exact imitation, the question arises, How far has the attempt succeeded?

In reply to this question we must first consider the position of the schools of the fly-makers. These formerly consisted — so late as twenty-five years ago, when Stewart and Pennell led them in England — of two prime followings, namely (1), the formalists, and (2) the colorists. At the same time there existed a third compromise party of mugwumps, which combined the two schools and eliminated the errors of each by the test of experience; and being then in the minority, they have now reached the majority, according to the inevitable laws of party history. But whether the "colorist-formalist" school of fly-tying has quite

succeeded or not in its theoretic professions will appear in the course of this chapter. On the face of it the truth would appear to be that the greater number of the many patterns now extant and in use as "Standard," "Fancy," and "Exact Imitation," *et hoc genus*, are, as a whole, of more æsthetic than practical use to the outdoor fly-fisherman.

The position of the "formalists" has been thus defined by Mr. Pennell: Trout take artificial flies only because they in some sort resemble the natural flies. If this be so, and if color is the only point of importance, why does not the "colorist" fish with a bunch of feathers tied on the hook promiscuously? Why adhere to the *form* of the natural fly at all? Evidently because it is found as a matter of fact that such a bunch of feathers will not kill — in other words, the fish *do not take the artificial for the natural insect.* If this be so, it follows that the more minutely the artificial imitates the natural fly, the better it will kill, and, by a legitimate deduction, that the imitation of the fly on the water at any given time is that which the fish will take best.

This is briefly the "formalist" declaration, and it is the creed which is held by most trout fly-

fishermen who are angler-naturalists, the world over.

But the "colorists" make reply in somewhat this way: Your theory supposes that the trout are better entomologists than the angler, or even the most skilled naturalists, and that they can discriminate between the hundreds of species of flies which frequent every river and brook during the season; and then you draw and work your flies up and against the stream in a way no insect ever followed, and the only thing, therefore, that the fish truly can do, is to tell the fly by its color. We therefore regard *form* as of comparative insignificance, and *color* as the first essential in every fly.

Now, both these theories are held to-day by thinking trout-anglers of experience, and I have met many of the most successful of them who stoutly maintained, out of their own practice, either one or the other lines of thought and method.

The truth, however, lies in a combination of both the "formalist" and "colorist" theories. There are certain axioms all must admit. Amongst the most important are the following: —

(1) The trout certainly take the artificial for the natural fly.

of 292 different trout, salmon, and bass flies; and of this number (issued as an authoritative list of standard patterns) there are just one hundred flies in which scarlet (ibis feathers, dyed swan, or silk) forms an illuminating part in the make-up. In seventeen, bright blue feathers or silk predominates, and in thirty-eight yellow in wing or hackle is the prevailing note. This leaves 137 patterns of mixed and dull-toned flies, and includes the fifteen exact imitations of the insect life of the English river Itchen, which have no simulacra in America. There are also twelve standard salmon flies in this series, and these and the Itchen flies should be subtracted as being out of the category of American standards. Our calculation, therefore, gives only 110 out of 292 patterns which by any stretch of the imagination could represent flies of the natural color.

It is evident to the most careless observer of nature that there are practically no scarlet, or bright blue, and only a few light yellow flies to be found in a state of nature. The yellow may-fly is distinctly the only yellow fly I know of; and it is quite likely that there are a hundred species of the actual insects on the ordinary stream which could be represented by the various tints of black,

white, brown, dun, yellow, gray, and combinations arising from shadings of the warmer and duller colors. The glaring riant reds, blues, and yellows are in the actual insect conspicuous by their absence.

It is not denied that these gorgeous creations of silk, tinsel, and feather have caught fish, nor that they will do so again; but the contention is that they are founded on *no plan* and are the production of "fancy" or imagination, — hence the terms "Marston's Fancy," "Flight's Fancy," "Wickham's Fancy," etc. If in their place a full supply of close imitations were used, a surer result could not fail to be attained, and the art of fly-fishing would in this country attain in due course to the refinement and certainty of the dry and wet fly-angling of the English chalk and mountain streams.

It is difficult to determine to what actual extent the old English patterns and those which have been copied from actual American insects are used in preference to "Fancy" flies; but for the purposes of this chapter I have had access to the records of one fly-tier, who with his wife and no other help has, during the winter months of the last ten years, tied some seventy-two thousand,

or five hundred gross, of trout, bass, and salmon flies,—mostly trout flies. Of these quite two-thirds have been patterns of flies of the more subdued colors and small sizes, with close imitations in body, setæ, wings, and legs of the actual fly. It is evident from this fact that, in certain quarters at least, a healthy opinion as to the right kind of lure has obtained. The flies in question were distributed by a firm of well-known western dealers in sporting goods.

There are two kinds of artificial flies of the "color and form" theory of fly-making: (1) the fly constructed for "wet" or "live" fly-fishing, and (2) that specially made for the "floating" or "dry" fly-fishing.

(1) The fly for the wet fishing is that almost exclusively in use in this country. It is made on the ordinary plan, with much hackle or legs, and in some cases—as with the palmers—the legs are wound up the entire body. This abundance of fibre is for the purpose of securing a vivid appearance of life as the fly sinks slightly below the surface of the water and the currents bend and agitate the hackle aided by the tremulous motion imparted by the angler through the rod and line. This movement gives life to the

bait, and hence the term usually applied to this form of fishing. All rapid rivers or streams are best fished with this fly; and as most of our American rivers have their rapids, it is obvious why this has been the accepted method from time immemorial. The (2) floating or live fly is usually made with proportionately large wings of single feathers turned the concave side out, or of *two pairs* of quill-feather slips, both of which devices add buoyancy to the fly and aid in keeping it on the surface of the water. The legs or hackle are reduced to a few fibres, as in the natural fly, and the body of the fly is either of quill or of some material having the greatest natural resemblance to the translucent body of the real gnat or dun.

This fly is used in slow-flowing currents or pools, and is always cast upstream and allowed to remain motionless and slowly floating on the water. Of course the "leader" must be of the finest. When a fresh cast is made, the rod is waved twice or thrice in air before delivering the fly. This motion dries any moisture that may adhere to the tiny lure, and it falls as softly as thistledown to float over the waiting fish, — a perfect resemblance to the actual fly. Hence this is often wrongly said to be "dead" fly-fishing, but as the actual

fly of the stream rises from the pupæ to the imago and floats without a struggle on the water,—its natural element,—this is much more closely an imitation than the struggling mass of fibres on the wet fly; for flies do not struggle on the water unless they be like "house" flies in the milk pitcher. This fact is the potent one in dry fly-fishing; and in England, where the chalk streams abound in two and three pounders, and the water is slow-flowing and without a ripple to obscure the keen vision of the experienced trout, no other form of fly-fishing is productive. I know whereof I speak, for in my "salad days" I had charge of the Itchen Abbas water for several seasons for Earl Northbrook, and that fishery was the finest of its region.

* * * * * *

The true theory, then, of the trout fly is the making of it in as nearly exact an imitation as the resources of the fly-tier will permit, and of course much depends on the fly-tier, for he must be an angler and a naturalist, as well as a good workman,—which is a rare combination.

PLATE 2

LAKE TROUT AND BASS FLIES

1. MATADOR
2. CHENEY
3. MOOSE
4. CASSARD
5. SPLIT IBIS
6. LAKE EDWARD
7. KINGFISHER
8. BLACK PRINCE
9. HOLBERTON
10. KOTOODLE BUG
11. MOISIC GRUB
12. ALEXANDRA

J. HARRINGTON KEENE *fecit*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Making the Trout Fly

There is no royal road to fly-making, — the expert becomes expert through practice, — and as each successive fly passes from his hands he finds that he has still something to learn, no matter how great his skill. I intend to make this chapter severely practical, and shall waste no words in describing the various processes of this delightful art.

The first requisite, of course, is the proper hook on which the fly is to be constructed. These hooks are of many kinds, and each has its followers. The Sproat, O'Shaughnessy, Pennell, and for small flies, the Sneck or Kirbed hook, are all good. Personally I prefer the O'Shaughnessy, both on account of its strength and its shape, though it would seem that a new bend, termed the "Perfect," brought out by Allcock, of Redditch, takes the prize for grace and hooking power. All of the reliable makers send out a good hook, and all the fly-tier has to do is to see that the temper and penetration of the hook are perfect before he affords his time in tying the fly.

The tools necessary for fly-tying are not many or complicated. Some fly-makers never use a

vise, but many of the smaller flies and most of the salmon flies demand a cleaner and more precise handling than can be given by the unaided fingers. The learner also will find his task far less difficult if he use the vise. This usually consists of a so-called jeweller's pin vise, to which a clamp for attachment to the bench is affixed. The cost of this is but trifling, and I always make my own. A sharp pair of shears or oculist's scissors are also indispensable; they should be finely pointed. A pair of spring pliers, by which a fine thread or tiny hackle is held secure on occasions, is very useful. A little turned hook made from a darning-needle (the point softened in a gas flame) is also handy when the tying silk accidentally becomes too short for handling.

A wax for the silk thread used in whipping the flies is, of course, necessary. Shoemaker's wax is not colorless, and is very sticky in a warm room. I prefer the following recipe for all purposes: 2 ounces of the best yellow resin; 1 drachm white beeswax, sliced; dissolve by heat and add $2\frac{1}{2}$ drachms fresh, unsalted lard; stir for ten minutes and pour into water; pull till cold. A good varnish is that of the white shellac. A few strips of gelatine should be placed in the bottle. This

absorbs any moisture which the alcohol of the varnish may take up from the air, and renders the varnish clear and hard when dry.

Most flies are tied on silkworm gut. It need hardly be said that this is the unspun gut of the *Bombyx mori* silkworm, and that the worm is taken when ready to make its cocoon and immersed in vinegar and the gut drawn out between pins, being allowed to dry and harden; after which it is boiled and the scale or outer skin drawn from it, usually through the teeth of the Murcian operator. Good gut is transparent and round, and through the magnifying glass should show no inequalities of surface. The practised eye at once detects faults, but the amateur fly-maker must largely trust to his dealer until his experience be sufficiently advanced to support his judgment.

The gauge or size of gut is, of course, chosen with reference to the hook to be used, and the gut should be soaked in lukewarm soft water — distilled if possible — for twelve hours before the loops are tied in the snell. A loop is tied at each end of the strand, and the gut is then strained slightly between two brass pins. This gives it a *set* of fibre, and the snell dries straight and even, and without twist or curl, if the gut be good.

One loop is of course snipped off at the length of the gut demanded by the fly-hook, and the snell is now ready to attach to the hook in the first stage of making the fly. The loop may be of any kind which ties firmly. There are several in vogue, but the ordinary "round and through" loop will do as well as the most elaborate, if drawn tight. A good plan in tying loops is to catch the loop over a hook screwed in the bench and with the tweezers take the loose end, and with the right hand take the long end and draw both tight. This makes a knot that will not slip or break in the coils.

Of course, when the eyed hook is used, the other end of the gut must be slipped through the eye and tied with a slip knot. This is not attached, however, till the fly is finished and out of the hands of the fly-tier.

The method of tying a simple hackle fly is briefly as follows: Attach the silk thread by winding it, well waxed, around the shank of the hook from bend to tip; then take the gut and lay it under the shank and whip closely down to a point opposite the barb of the hook. Now take a hackle feather — say from the neck of a game rooster — and proceed to prepare it for attachment in this

wise: Take the point end of the hackle between the left finger and thumb and draw the hackle through the right finger and thumb, so as to spread out the fibres from the midrib. Then shift the left forefinger and thumb to the butt of the hackle, and take the tip of the hackle between the first finger and thumb of the right hand, with the reverse side of the hackle underneath. You have now the two ends of the hackle held between the two hands. Now reach out the middle finger of the right hand — still holding the hackle securely — and pass the nail from you toward the butt of the feather on each side of the midrib, alternately, so as to reverse the set of the fibres in a downward slanting direction. This process is termed " turning the hackle," so that when it is wound round the hook each fibre stands separate and free of its neighbor, which cannot be accomplished by the old-fashioned method. The " turned " hackle is now ready to go on the hook, and that process is as follows: Place the hook in the vise, with the snell to the right; attach the tip of the hackle by two turns of silk to the shank opposite the barb; pass the silk out of the way in loose coils round the snell; take the butt of the hackle between the right forefinger and thumb

and wind it in loose coils — three or four — around the shank until you reach almost the end of it; then tie the hackle, smoothing the fibres back with the finger and thumb of the left hand; tie with two half hitches, and your fly is made.

This fly is, of course, only the typical buzz or palmer, and represents one of the larvæ of water flies without wings. By some it is termed a spider, and it may be said closely to resemble one. The shank of the hook and the whipping forms the body.

Different shades of silk and other materials, such as mohair, worsted, wool, quill strips, ribbed or not, also, as the case may be, form the bodies of the palmers; and the hackles, so-called, are usually made by attaching the hackle feather at the shoulder or end of shank and winding it closely in coils. All anglers are familiar with these simple forms, and they are mentioned merely to introduce the "turning" of the hackle, which is one of the most important processes at the basis of fly-making.

The bodies of all flies need to be as soft and pliable as possible in all cases, that they may resemble the body of the actual insect. Detached bodies are made of various plastic materials, such

as soft rubber, cork, and twisted feathers. When they are formed of bristle, hair, or quill, and stand out from the shank of the fly, it is quite questionable if they are more successful than the close-bodied fly, owing to the fact that the texture of the material is not fly-like when tested by the sensitive mouth of the fish. Every angler knows how quickly a trout ejects a strange or foreign object from the mouth, though it may have been deceived through the sense of sight.

The wings of trout flies are principally of feathers, and almost every feather is likely to be found useful by the fly-tier. First, of course, come those birds whose texture of feather most closely resembles the gauze-winged *ephemeridæ*, and in Britain the starling furnishes the majority for the various duns. So also for the may-flies, the freckled under-wing feathers of the American wood-drake are indispensable; and the pheasants, partridges, grouse, and all the wild fowl native to the British Islands are pressed into use. In America the variety of fly-tying is even greater, and for trout almost every gorgeous feather has gone to the making of a lure for the "salmon of the fountains."

Among the feathers most sought after are the

breast and wing, as well as coverts, of all the wild fowl. These furnish most of the wings of the *ephemeridæ*. The wild and tame turkey, especially the former, the peacock, the peahen, the ibis, the swan, brant, and a host of others are useful, and the angler will do well never to forget how useful the hackle feathers of white, brown, gray, black, and in fact all roosters, are, in the fly-tier's accumulation of material. Those feathers which make the best wings are of well hooked or matted fibres. Some feathers, such as those of the blue heron, though valuable for strips, do not hold together well and soon lose their cohesion in the water.

A winged fly in this country is held to be stronger and more durable when the wing is "reversed." In England the reversed wing is seldom seen. This term needs a little explanation. Instead of the wing being tied on at the head of the fly *after* the hackle (or legs) is attached, they are tied on with the tips pointing away from the bend of the hook and in the direction of the snell; and after the hackle is secured these wings are turned back side by side and strongly tied with the tip points in the way indicated by the natural fly.

The right way to select the feathers for such

wings as are not single feathers only, is to take a suitable strip from the right and left feathers of the bird. No two strips can be taken from one feather and put satisfactorily side by side for a pair of wings. They must be of opposite sides to fit each other, but may be placed concavely or convexly together, as seems best. The only way in which one piece of feather can be made a passable wing is by folding or rolling it in three folds. It is seldom that even the expert does this, however, for the obvious reason that it is not the best way, — unless one is very short of feathers, — and of course it may then arise that the tailor must cut his clothes according to the amount of cloth he has to work with.

The wings of floating flies are usually single feathers, such as those of the mallard's breast, and to cause them to float the fly to which they are attached, they are tied back to back, or with the concave sides outward. This renders the fly very buoyant, and can be applied to almost any fly. Another method fast becoming prevalent in this country, is the doubling of the ordinary wings and the placing therefore of two pairs of wings on the fly instead of one pair. This needs that when the fly is lifted from the water it should

be waved in the air and some of its moisture dried out before the return cast is made. Sometimes a little vaseline on the wing will help to float it.

In some trout flies, such as the Parmachene Belle, the fly has more than one colored feather in the wing. Of course this is always so with salmon flies, but is the exception in the construction of those designed for trout. The wings are placed on separately, — as a rule, — the red ibis over the white swan in the fly in question, and both are tied down without *reversion.* Such flies as the Silver Doctor, Jock Scott, and others which, from being exclusively salmon flies, have been taken over for trout, have very complex wings and bodies, and must be treated separately under "The Making of the Salmon Fly."

Using the Trout Fly

The literature of the *use* of the artificial fly is overwhelmingly voluminous, and no one, however skilled, can hope to add anything new to the story of this "gentle craft." The most the present writer can do is to gather a few of the practical lessons he has learned in nearly forty years with

the fly-rod and tie them together as a bouquet of wild flowers for the young angler. "Nothing is new but that which is forgotten" on this ancient earth; and assuredly the saying of the philosopher by this time applies to the use of the fly, which dates at least from the time of the Macedonian "hippurus" described by Aelian as having been used on the River Aestreus. Perhaps Adam, in *medio ligni Paradisi*, whipped the rivers of Eden, — Gihon, Pison, Hiddekel, and Euphrates. Who knows?

Be that as it may, the modern use of the fly needs skill and patience and the twentieth-century consummation of art for its best results. The fly itself must be, as I have tried to show, of close imitation of the actual insect and constructed of the softest and finest material. Assuming that the angler is thus provided, the first question concerns its presentation to the fish.

As I have before intimated, there are two general styles of flies. The usual and most used is that which is cast on the water and is intended to represent the live fly partly sunk beneath the surface. This fly is worked with enticing motion through the water, and, being well hackled, is closely imitative of the living insect. Without

doubt the trout is attracted by this semblance of life. The fly may be cast up or down, across or obliquely, as the exigencies of the stream dictate, and in waters where the fish are plenty and not too much fished it is the most successful method, without doubt. In any case it utilizes the thousand and one patterns of flies known to the fly-fisher, and it is for this purpose they are built.

The other make of fly, as has been intimated earlier, is the "exact imitation," — a floating fly which depends most on its identities with the actual insect for its consummate efficiency. These flies have their origin in the chalk streams of England, where the water is of crystal clarity and seldom over six feet deep, with a soft-flowing current of about two miles an hour. Here and there are riffles and shallows, and here and there are hovers and hiding-places for the large trout; but the coverts for the angler are not many, and he is obliged to creep and crawl, and take every possible advantage of uneven ground, that he may escape the unequalled vision of this brown trout, which feeds on the minutest flies of the world,— the diaphanous and most microscopical of ephemera.

The floating flies are tied on the eyed hook or

not, according to the taste of the user, from the No. 6 to the No. 16, or even No. 18 hook; for I have tied and used them on the latter. The delicacy of such flies surpasses belief, unless they are seen; and it is my personal experience that the very small flies are the most attractive, and that, properly presented, they hook more fish than the large flies so much in use on our own waters. A No. 10 is a small fly for American anglers, but there is reason in a minute fly. In the first place most of the fly food of trout of all kinds is of very small insects, and the small hook usually only pierces the tough skin on the jaws of the fish and cannot sink through the jaw, as in the case of the larger hooks. At first glance this would appear a reason why the very small hook should not be used; but the fact is that the small hook engages the toughest membrane in nature, and cannot tear out or be ejected by the struggling fish, whilst the large hook, which makes a complete perforation, is often ejected through the orifice it has made. My experience in two continents teaches me that success in trout-fishing is at least fifty per cent greater with small than with medium and large flies, and twenty-five per cent more with the floating than the live or sub-

merged fly of the ordinary pattern, — all things being equal, of course.

The floating fly is always fished "fine and far off." The gut leader is of the finest "undrawn" gut, and only one fly is used; two trout at a time, as often happens to the live fly-fisherman, would be embarrassing to the floating fly-angler, to say the least. The angler always casts up-stream, and the cast must be so made that the fly drops on the water first. This needs the most delicate and precise manipulation, and in its accomplishment I need scarcely say that practice alone makes the perfect cast. The fly is allowed to float down to within a few yards of the fisherman's feet without the least agitation, the rod being gently raised so that no undue loose line may lie on the water. The eye of the angler is keenly fixed on the descending fly; and when the psychologic moment comes for the rise of the fish, he strikes with a sharp impulse of the wrist and, *habet!* he has it. Then comes the "tug of war," and the generalship of the angler needs its greatest extension. The point of the rod must bear the strain; it must ever be at a less angle than forty-five degrees to the surface of the water; its resilience must be employed to restrain the struggling and gallant

quarry, and every rush restrained with judgment, till, exhausted and resigned, the incarnadined beauty of the water lies in the landing-net, subdued but not conquered.

The great secret of successful fishing with the floating fly is the stalking of the fish from behind as it lies with its head up-stream, and its marking down as it takes the natural fly from time to time. The dry fly-angler drops the fly within the last circle of the rise, and no snowflake ever kissed the water as softly as this tiny quill gnat or dun midge touches the curling eddy, cast there by the expert dry fly-fisherman.

The graceful and true casting of the trout fly depends largely on the proper selection of the rod and line. The indispensable features of a good rod are briefly as follows: Lightness, strength, an elasticity which springs from handle to tip evenly, and a careful adaptation of the length and weight to the strength of the user. The reel is not of prime consequence, and any good make will do well enough. The line should be of medium thickness. I prefer quite a heavy braided silk line, which has been dressed in boiled linseed oil under an air-pump for some ten days, and then stretched moderately tight between supports in a

dry place where the air is fresh and about sixty degrees. The superfluous oil should be wiped off with chamois leather as many as three or four times during the first week or so, and then allowed to dry naturally, till it is quite free from evaporation. This will require several weeks to harden, but must in no case be hurried in the process.

The actual operation of fly-casting cannot be taught in writing, but certain directions may be given which will be of use to the novice. The most common is the overhand cast, and this consists, as its name implies, of a principal motion of the rod which is overhand. To begin, the leader, line, and flies are drawn out by the action of the stream until some twenty-five or thirty feet of line has elapsed between the tip of the rod and the end of the fly or dropper. With a smart upward and backward movement of the rod this line is recovered from the water and urged directly backward to its full length. When this is reached, the rod is impelled sharply forward, and the result should be that the leader and dropper lie straight out in the water. This sounds exceedingly simple, but there is a knack in it which depends on the sense of balance at the psychological moment when the fly is fully extended behind the caster.

HOOKED!

Some there are who never fully learn to perceive this, and these pop off their flies as a teamster snaps his whip-lash. The best practical plan to teach this lesson is to have a sharp-eyed friend to utter the word "go" just before the crucial moment. I say "before," to allow for the transmission of thought, and so inform the caster when the fly lies momentarily straight in the air behind him. Casting on a smooth lawn has been recommended for practice, but I prefer the water as being more informing of the various exigencies that arise.

The same method obtains in dry fly-fishing, with the exception that the fly is sustained in air to dry it during several false casts, and with the intent to aim exactly where one desires. It is obvious that if the line be returned before falling on the water, there is the possibility of another and better cast, supposing the preceding one to be inadequate; and this without alarming the fish.

Other forms of casting are in vogue amongst the experts in trout-fishing, but they are only used when the old-fashioned cast is not possible. Of these the "wind" cast is very useful. It is used when the wind is dead against one, and is made thus: The line, with the full strength of the arm,

is propelled up overhead, and then the rod is brought right down in the teeth of the wind till the tip almost touches the water, without pause. The full strength of the rod is exercised, and a heavy line is most successful in this cast.

The "underhand" cast is made by drawing the rod close to the water, either to the right or the left. The rod does most of the work, and the cast is an easy one. It is intended to be used under overhanging boughs, where the "overhand cast" is impracticable.

The "flip" cast is used to reach the obscure hovers which will not permit of the other castings. The rod is taken firmly in the right hand, and a few coils of the line held loosely between the reel and the first guide; the fly is taken carefully, but securely, between the tips of the left finger and thumb, so that the barb will not penetrate, and the rod is then bent in spring shape, so that when the fly is released it is propelled to the desired spot. Sometimes this is a most useful cast.

The "switch" cast is the great cast with which the late Harry Pritchard and his son used to achieve such long-distance casting. It is somewhat similar to the "wind" and "Spey" casts, but has its own indescribable peculiarities. A sudden

rolling motion is given the tip of the rod, and both hands are brought into use, the left hand steadying the butt of the rod as a fulcrum. The result is a rolling motion of the line, which unfolds in spirals, dropping the fly last instead of first. The "Spey" cast is mostly used by the salmon fishermen of the Spey, and will be described in its place.

There is an art in striking a rising fish, and the precise movement and moment is hard to define. The quicker the hand answers to the eye in fencing, the better the fencer; and, similarly, the quicker the strike when the fish has risen, the surer the hooking of the fish. A quick wrist motion is generally the best, and a moderately stiff rod is the kind I prefer for precision and penetration.

On hooking a trout the first mental quality to be brought into action is coolness. All flurry is inimical to the proper playing of any fish, and especially of the trout. Having evidently hooked the trout, it is necessary to keep the point of the rod well up, that the strain may be not so much on the line as on the rod. Do not indulge the struggling fish too much. Seek to let him know his master, that he may not unduly disturb the water

and other fish also. Do not let out too much line, but observe that slack line is a fatal evil; for if the hook be only fixed loosely, the fish relaxes the hold and shakes out the point and barb. If a fish enter a patch of grass or weed, boldly endeavor to irritate him to extricate himself; for you cannot, as a rule, draw him out violently. The landing of a fish should also be deliberate. It is much better to play it a longer time than endeavor to get it into the landing-net until fairly exhausted.

The Theory of the Salmon Fly

There has never been any doubt that trout and bass feed in fresh water on insect life; and it has, therefore, not been hard to account for these fishes taking the artificial fly, whether it be an exact imitation or what Charles Dudley Warner termed a "conventionalized creation."

It has, however, been gravely doubted until recent years that the *Salmo salar* ever took food from the time it entered fresh water, in the yearly migration for family purposes, till the time it, in the ordinary course of nature, dropped back again into the ocean for recuperation and growth.

If, as has been asserted by many experienced

anglers and pisciculturists, the stomach of the salmon in fresh water never disclosed the remains of food, then the fact that this fish is caught readily on the artificial fly lacks the support of any plausible theory. That the fish could be taken with other bait than the fly seems to have been believed as early as the "Boke of St. Albans," wherein the good Dame Berners says,

> "Ye shall angle wyth these baytes when ye maye gete theym. Fyrste wyth a red worm . . . and also wyth a lob [the lob or garden worm] that bredyth in a dunghill . . . and ye shall also take hym wyth a dubbe [fly] in like mannere as ye doo take a troughte or a graylynge."

And old Barker (1655), in "Barker's Delight," thus versifies his chapter on the *Salmo salar:* —

> "Close to the bottom in the midst of the water,
> I fished for a salmon, and there I caught her.
> My plummet twelve inches from the large hook,
> Two lob-worms hanged equal which she never forsook;
> Nor yet the great hook with the six-winged flye,
> And she makes at a gudgeon most furiouslie.
> My strong line, just twenty-six yards long,
> I gave him a time, though I found him strong.
> I rouled up my tackle to guide him to shore,
> The landing-hook helped much — the cookery more!"

Although not much reliance can be placed on

these quaint old authors, it is abundantly certain that salmon are frequently caught on natural bait. The worm is used to this day in some British rivers, and the shrimp and prawn are deemed very killing in the estuaries of many Scotch rivers. Moreover, the salmon will take the "phantom minnow," which is made of fine silk, painted to represent the young salmon or parr or small trout. There can be no doubt of this. It is done to this day, though, of course, is not considered sportsman-like. I once caught a fresh-run ten-pound salmon below Tewkesbury on the Severn with a natural minnow impaled on a flight of hooks, and used in the manner known in England as "spinning."

And what say the authorities about the feeding of *Salmo salar* in fresh water? I do not refer to the Pacific salmon, of course. Mr. Charles Hallock, in "American Game Fishes," says: —

"A great deal of bosh has been written in all the books of the salmon for four centuries past, about salmon not eating when ascending to their spawning grounds, but that theory is now wholly exploded. They not only eat, but eat promiscuously and voraciously of a great variety of food, including young *salmonidæ* and other fresh and salt-water fish fry, shrimps, prawns, sandworms, crustaceans, cephalopods, and floating invertebrata. Another impression is, or was, that

salmon could only be taken with the fly; whereas they readily take natural minnows, prawns, worms, artificial spoons, and a dozen other kinds of bait, as has abundantly been tested and proven. . . . It is remarkable that this question should have remained open for so many centuries and that none of the books have set the matter right."

Thus Mr. Hallock, the dean of American sportsmen, declares, and we must heed such an authority. He goes on to explain exactly why the idea obtained that salmon do not eat, and I refer my readers to his impregnable explanation, having no space for it in this chapter.

So also Brown-Goode, in "American Fishes," concedes that they feed in brackish and fresh water. Mr. George M. Kelson, the champion English salmon fly-caster and salmon angler, says: "I have had evidence of an abundance of food being actually found in the stomach of a fish of nine pounds in weight, caught high in the Scotch Tweed. The food consisted principally of stone flies," and he quotes from the letter of a friend who had opened thousands of salmon: —

"'I have seen salmon feeding in both river and lake. I am simply astonished that any person could maintain that they do not.' The same authority goes on to say: 'Salmon are no doubt heavy feeders while in the sea, and also while in the

estuary. I have taken no fewer than eleven herrings out of a ten-pound grilse, caught at the mouth of the Ayr. I saw at Dalmeny five sprats taken out of a salmon. A salmon caught at Kincardine had in its stomach seven sparling, besides other small shrimps; another, caught high up the Forth, at Polnaise, contained a smolt and eighteen shrimps; one taken at Craignorth Cruives, twenty-seven young eels; others having swallowed a trout fully half a pound and every imaginable insect, flies, beetles, worms, and spiders. So it is all nonsense to say that salmon, when in fresh water, live upon love.'"

And yet one other piece of evidence: —

"I quote from a letter I have of 'Nahanik,' a celebrated Irish fisherman of twenty years ago. He says: —

"'The fish in different fisheries feed differently. There are the three fisheries on Galway Bay, Galway, Screebe and Ballynahinch. In Galway the fish will take the shrimp better than anything else; even above the tideway, or rather above high water of neap tides, they will also take the fly; but, if I remember rightly, not in the regular tideway. In Screebe the fish out in the regular tideway and in Lough Athalie (brackish water) take the fly better than anything else; but in Ballynahinch I have known men trying every turn in the tideway without ever catching a fish, although they were rising at the natural fly; but up in the fresh water at Derry, Clare, Butt, they will take the shrimp. I have watched a salmon pool for hours; at times the fish rise and try to drown the fly, but at other times they come up gently and suck it into their mouths.'"

The above evidence seemed necessary to forever settle and fix the fact that salmon feed in the rivers

they penetrate for spawning purposes. In order to arrive at any rational explanation of the theory of the artificial salmon fly it was imperative that this truth should be insisted on; otherwise no intelligible reasons for the making of this poem of color and form could be given, unless, indeed, we adopt the sounding theorem of one eloquent writer, to wit:—

> "As the harmonies of sound depend on the certain natural 'intervals' furnished by the harmonic chord, so in forming harmonies of color [in salmon flies] the natural or prismatic arrangement as displayed by the solar spectrum of the optician must in every case be taken as a basis."

From a theoretical point of view there may be something in this, but not much in practice, I think.

Blacker, the Court fly-tier in the early part of the nineteenth century, of Soho, London, was the first one to place the making of the salmon fly on its proper basis as an art. His beautiful hand-painted illustrations in the little book which bears his name are rare and authoritative, and no one has excelled his creations. Later, the long list of Mr. Francis Francis, in his "Book on Angling," settles the orthodox patterns, and most of them remain killers to this day, over the water.

Some fifteen years ago a renaissance of salmon fly-tying was attempted in the pages of *Land and Water* (the original organ of Frank Buckland, of sacred memory) by G. M. Kelson, before quoted, a well-known and supremely skilful angler, fly-tier, fly-caster, and writer, whose creations in salmon flies, and expositions, appeared in many numbers of that journal. I have before me the colored illustrations of the whole set of standard patterns, in some cases in sixteen colors, and exactly, beautifully, and chastely executed. There are no reproductions extant that are so perfect, and they represent flies tied by Kelson for the purpose of establishing the recognized standards and illustrating his theories, on which many of the most killing flies were built.

It is not necessary here to give a list of these flies, but it includes the well-known patterns and many new ones, largely derived from Major Treherne's collection. What I wish to refer to at this time is some of the points which accompanied the publication of this series. In brief they were as follows:—

(1) A bright fly in bright or clear waters should be used, leaving the sombre patterns of deeper dye for discolored and shaded districts.

(2) There is a predisposition of certain rivers to particular classes, colors, and sizes of flies.

(3) In still, deep pools, a small fly should be used. The fish come from a greater distance for a small fly, except in very cold, rough weather.

(4) In rivers clear as crystal, use the most showy feathers in flies dressed small, to attract the attention of the fish; then follow with a fly dressed in the same pattern, but with its feathers less marked, or in fibres.

(5) Salmon can be taught to take the fly; instance the English Avon and Test. In all cases Kelson believes that the salmon has been educated to take the fly.

(6) Adepts in the science of fly-making draw their conclusions from local surroundings in summer time with almost miraculous effect, and as a rule foliage is one of the chief guides in experimenting. Autumn leaves looking down on the water shed their influence without a motion or sound. It is the angler's duty to reason from them.

In addition to these axioms the new theories of "condensation" and "exaggeration" may be briefly noticed. The meanings of these terms simply are that when the salmon will not rise to the ordinary

fly of the water,—a fly like Jock Scot or the Silver Doctor, and known to be a killer,—the angler resorts to a fly which either *condenses* or *exaggerates* the known pattern. "Condensation" means the use of fibres of feathers instead of whole feathers, and "exaggeration" means the use of larger and more striking strips and whole feathers in the place of the modest and symmetrical dress of the ordinary pattern. The modern school of salmon fishermen, at the head of which are Mr. Kelson and Major Traherne, swears by this method of rousing sluggish fish; and the idea is certainly worth consideration, especially as both these anglers are most successful in practice. But whatever conclusions may be ultimately arrived at, every sign points to the theory that salmon, like trout, rise to the fly, mistaking it for some form of insect life, and take it for food, and not for a mere mirage or phantasm.

Making the Salmon Fly

The salmon fly demands more skill in the making than any other fly. This is a truism. It calls for a knowledge of materials that is never too full and complete, an artistic sense in the

selection of colors and their blendings and contrasts that is ever striving for greater results, and a skill in the making which surpasses that necessary to the most exquisite work of the jeweller. In fact, some of the creations of the salmon fly-maker are veritable jewels in feather, silk, and others of nature's most gorgeous fabrics, which are not outshone by the greatest gems of other arts.

To plunge *in medias res* of the practical making of the salmon fly, a few remarks are first necessary in regard to the hook. What is the best hook? This is the common question put to experts by the learner; and the answer is hard to give, but not impossible.

There is no doubt that the old famed O'Shaughnessy has stood the test royally, and is still thought to be the best by the majority of salmon fishermen and fly-tiers. The hand-forged "irons," as they are sometimes technically termed, hardened and tempered by the most expert workmen, and separately tested, seldom prove false; and though the penetration of the hook is confessedly not faultless, it is equal to any hook in holding power, when once the fish is hooked. The Sproat no doubt excels it in penetration; but every angler of experience knows that the

Sproat has the miserable habit of enlarging its embrace and widening its bend, and so relaxing its hold. Many a noble fish has been lost through this fault, apparently unavoidable because structural.

These two shapes of hooks were practically the favored two until, about thirty years ago, Mr. Pennell invented his combined Sproat and Limerick (or O'Shaughnessy) hook. There is no doubt that it is a great improvement on either hook in several ways; but it is not a great deal better, in my opinion, than the Limerick, in penetration, though it greatly excels the Sproat in holding power. At all events, it is a thoroughly well-made and well-tested hook, and has met with great favor.

This hook is also made in the Sproat bend, for those who like that hook, and its greater strength in the wire makes it a better hook than its prototype. All the Pennell hooks, besides being made with tapered shanks, are also eyed with eyes either of up or down inclination. The war between the armies of "up" and "downers" no longer wages, but I doubt if the fight is yet over amongst our cousins beyond the seas. I have always preferred the Limerick — O'Shaugh-

nessy, — because it is an old and tried love of mine, but the Pennell hooks are undeniably fine weapons; and I can say very truthfully with the poet,

> "How happy I could be with either,
> Were t'other dear charmer away."

One of the conveniences of the Pennell eyed hooks is, of course, the readiness with which the fly can be tied on the leader. The end of the leader is softened, slipped through, and a simple round knot tied to include the shank, pulled tight, and the trick is done. To the tapered shank and hook (minus the metal eye) one must wind tightly a loop of twisted gut. Some say this acts better than the metal eye; and I think it does. This is why: —

There are two distinct makes of eyes: one that has the shank folded back at the side on a loop, and pressed closely to the side of the main shank, like the loop of the letter *l*; and the other is a round eyelet of wire at the extreme end of the shank, and standing out, looking up or down, according to the fancy of the buyer. On tying the fly, its head must be placed some distance from the end of the shank and the eye, to allow of the necessary knot; and I have repeatedly found that

this knot is likely to form an excrescence which slightly interferes with the perfect level of the fly, so that it is sometimes liable to skirt or wabble when being fished. With the loop of gut this never occurs. That's why!

So much for the salmon hook. The anatomy of the salmon fly needs to be briefly detailed, that the tyro may know the various parts and their positions. Taking a comparatively simple example, — the Silver Doctor, — it may be thus dissected: —

(1) The *tag* is of several turns of silver twist or fine wire wound opposite to the point of the hook on the shank, followed by two or three turns of dark yellow silk floss, and secured by a turn of the tying silk.

(2) The *tail* is a golden pheasant crest feather, tied in next the tag with a small blue feather of the kingfisher.

(3) The *butt* is a couple of turns of dark scarlet wool yarn next the tail on the hook, and secured by two turns of the tying silk, as before.

(4) The *body* is, first, white floss silk tied in next the butt; then tie in a strip of flat silver tinsel; then a length of oval silver tinsel. Make these secure, and first wind the floss silk smoothly over

the shank of the hook to within an eighth of an inch of the extreme end, securing it; second, wind on the flat tinsel to the end of the silk, covering it up smoothly and securing it; third, wind the oval tinsel in a coil about six turns up the body, and secure it. This last forms the (5) *ribs* of the fly.[1]

(6) The *throat* of the fly is at the upper part of the body, of course. A blue hackle (stained) and a hackle from the guinea fowl are superimposed in the order indicated.

(7) The *wings* of the Silver Doctor are connected strips from the tippet of the golden pheasant, from the barred feather of the wood duck, pintail, tail of the golden pheasant, swan dyed light yellow, and light blue brown mallard side feather, and Siberian bustard. Over this combination a crest feather of the golden pheasant droops with its golden rays.

(8) The *horns* are two separate fibres of the tail feathers of the blue macaw, and are placed in each side of the head of the fly.

(9) The *head* is of dark scarlet wool yarn, two

[1] The under body of white silk should be perfectly smooth, so that the silver body appears like a polished silver tube of equal diameter throughout.

turns, and secured by two final half hitches of the tying silk. The fly is now finished.

Thus, in the ordinary salmon fly there are nine separate parts, which must be adjusted with skill and nicety and with a proper sense of proportion, to be handsome and effective as a finished fly.

In the Silver Doctor there are, all told, some forty pieces of material, including the hook. In the Jock Scott there are at least ten more, and in the "Chatterer" there are some 150 feathers of the Blue Chatterer on the body alone. Of course much simpler flies are made and much used, and for my own part I am of opinion that it is a needless waste of material to tie such a fly as the Chatterer. The rich dressings of the Silver Doctor, Jock Scott, and others of that ilk are apparently necessary; and the capture of a lordly fish of a score or more pounds' weight amply repays the labor of making the fly, in the sense which results of rich artistic triumph.

There is nothing recondite in the making of any part of the salmon fly which the trout fly-tier does not readily apprehend. The tag body and hackles are arranged in the same way, and the wings are laid on and not reversed. The expression "connected strips," used in describing the

wings (7), means that the strands of each feather are connected or married to their fellows by means of the hooked appendages of the fibres of the feathers. Thus, in making wings we have several composite wings paired and tied, forming a harmonious and beautiful variety of color and texture in one assemblage of feathers. In tying on each set of wings it is necessary to use the greatest care that they be set precisely upright at their bases; and of course, where there are jungle cock or other feathers for cheeks and horns, the latter are placed on the hook after tying the main wings.

Natural feathers are always used when possible, but the red, yellow, and blue strips of the swan must be dyed when required. This can be done easily by means of the aniline dyes; though where the dyer is a professional, he will do better with the wood dyes than with the aniline. In small flies the red ibis furnishes the scarlet strips, and should be always used when long enough to fill the purpose properly. All wings must be of matched feathers; that is, strips from the right and left feathers of the birds, and the pairs are always placed inside to inside. To this rule in salmon-fly making there is no exception.

Using the Salmon Fly

The consummate use of the salmon fly depends largely on the fitness and adaptation of the several parts of the tackle, of which it is the apex and the *point d'appui*. It is necessary, therefore, in applying the salmon fly to its proper purpose, to consider the various parts of the salmon angler's outfit in their proper relationship. This I propose to do with the utmost brevity, endeavoring to be plain, precise, and practical.

The *rod* is most important, and must be proportionate to the strength and size of the user. If the water to be fished be wide, a long rod is better than a short one. The rod I prefer is the Castle Connell, of some sixteen feet in length, with enlarged butt, and tapered, so that it bends equally from tip to butt. It is astonishing how easy such a rod is to wield and how powerful it is when fighting a fish where the stream is strong. Of course the rod is of spliced joints. I do not find the cane-jointed rod so reliable, and for the Castle Connell, old, well-seasoned greenheart is the very best wood. I have one made by Dalzell, of St. John, N.B., which is sixteen feet six inches, and the wood came out of the greenheart timbers of

an old wreck which had lain in the Bay of St. Andrews for many a decade. This rod has done wonderful service, and is yet as stanch and elastic as on the day I received it from the maker. Washaba has been recommended, but I have no experience of it. The guides on the rod should be upright and not the ordinary rings, so that the line may run as freely as possible on all occasions.

The *line* may be of any good make of braided silk, but must be dressed with an efficient oil dressing to waterproof it. The recipe given in the preceding section will do admirably. Its length ought to be at least three hundred feet, and I have always felt that there was a loss of strength and little advantage of any kind in having a tapered line. After being used, on all occasions the line should be carefully unreeled, and dried in loose coils on a chair in a warm room. This is very important.

The *reel* is a matter of considerable importance as to principle. It needs to be large enough to hold the line easily, and large enough in the barrel to reel up easily. The check or click must not be too stiff in its working, lest the suddenly plunging fish find a dead point, and snap the line. The best material for reels, in my experience, is a com-

bination of ebonite and German silver, the latter protecting the former, so that in the event of a fall on the rocks the metal takes the blow.

The above appliances may be termed the permanent part of the salmon fisher's tackle, and, as such, demand care and experience in the selection. Care of a more solicitous and continually changing kind is demanded by those parts which require constant renewal; namely, the leader or casting line and the fly. The casting line is, of course, of the best salmon gut, and it should be round, transparent, of even gauge, free from flaws of all kinds. A powerful magnifying glass should be passed over each strand as a test of the preliminary selection, and all strands should be rejected that are in the least flat or faulty. The chosen strands are soaked in distilled or filtered rain-water, or, better still, in fresh milk and water, which seems to take from the silvery gloss which occasionally mars an otherwise fine strand. The casting line is made of three twisted or plaited strands to the extent of four feet; then about four feet of double gut, twisted; then follows a length of the best single gut for some four feet. A tapered cast made in this way is most agreeable to cast, and aids the angler to lay out the fly with precision and light-

ness of delivery. No leader should be more than fourteen feet long, for several reasons, the chief of which is that it must never be drawn through the tip guide, there being danger of breaking when a fish is on the hook; and if the leader be longer than the rod, this may advertently be done. The selection of the salmon fly depends, as a rule, largely on the traditions of the fishery. This is more so in much-fished rivers than in those of comparative freedom from the rod. Many anglers would only use the so-called "standard" patterns, and would not think of trying experiments. Others think that pattern counts very little, and that size is all important. In my opinion, however, the chief point to be aimed at is to make the salmon *see the fly*. If he be feeding, and the fly be in harmony with the surroundings and of the right colors to attract attention with reference to atmosphere, foliage, clouds, and light, the fish will take almost any lure within these limits. At the best, the whole question is one of individual judgment, when that judgment has been qualified by experience and observation; and until then the learner had better "follow the leader." And let him never forget that he who catches the greatest number of fish is the one who keeps his line in the water the most!

The methods of casting the fly in salmon-fishing are fundamentally the same as in trout-fishing, only with more force and less delicacy. One method of casting, much in vogue with British anglers when wading, is termed the "Spey" cast; and as it is *sui generis*, a short description from one of its greatest professors, Major Traherne, may be quoted here. Writing in June, 1886, he says: —

> "To make a long Spey cast, the salmon fisher requires a rapid stream to work in, which will, before making every fresh cast, carry his fly down-stream to the full extent of his line straight and taut, the point of his rod being held as low as possible for that purpose; then, by suddenly raising the rod very high, the line is lifted out of the water to the very end, and without a moment's pause the rod is carried up-stream to the right or left (as the case may be) by a rapid motion, but not so rapid as to send the fly too far up-stream past the angler, the object being to let the fly strike the water just above where he is standing, at which moment the whole of the line is on the reverse or upper side of him. Then, with a sweep peculiar to this particular cast, the line is propelled over (and not along) the surface of the water, after the fashion in ordinary casting."

It is not likely, however, that this cast will be found generally suitable to the salmon rivers of Canada and Maine, the "switch" and "over-

hand" methods being those most in use according to my observation and information.

On reaching a salmon water at the head of a pool or catch, the first thing to do is to select a fly suitable to the conditions of the water. This is, of course, a matter of tradition, history, or immediate experience, and must be determined from one or the other. One thing about the fly must be observed. It must be tested and found to be perfectly true-floating, and not skirt the water. Nothing scares a salmon so much as a fly that makes a ripple.

A pool which has a good stream running through it should be fished somewhat as follows: Go to the head of the pool and throw well and down-stream, covering all the likely water. This, of course, means a long cast, but it is better than casting straight across, because the fly lies long over a possible fish, and the current will keep the line tighter, so that the chances of the fish hooking itself are greater. More motion can also be imparted to the fly, by reason of the greater tautness of the line.

To fish a slack pool is much more difficult. A long line here is difficult or impossible. A short one must be cast, and the rod pointed up,

and the line kept tight. One must strike hard to hook a fish on a line like this.

If a fish strike and miss the fly, finish fishing the pool and come back again in half an hour. He will probably be ready then.

A jerking motion should always be imparted to the fly. This is produced by raising the tip of the rod a foot or two every few seconds and letting it fall again. The movement of the fly undoubtedly has a tendency to attract the attention of the fish, which the fly, without spasmodic movement, would not do.

When the salmon is hooked, he should be dealt with somewhat as follows: Hold the tip of the rod up so as to bring the fish to bear on the spring of the rod. This must not be forgotten. See that the line is free, and not looped round the reel or butt of the rod; be ready to give what line the fish needs to prevent breakage, but be very sparing, and put all the pressure you can on him. If he springs out of the water, lower the tip of the rod. Should he go to the bottom and sulk, get below him and endeavor to draw him down-stream. If he will not move, pelt him with stones. If this will not move him, take a newspaper or old letter and slit it, placing it on the

line, and causing the water to force the obstruction down to the fish. I have known a newspaper to start a large fish when nothing else would do it.

When the fish is thoroughly tired out, it should be, if possible, brought into shallow water; and if a moderate fish of say eight or ten pounds, it should be landed by means of the landing-net. The net should never be thrust at the head of the fish, but should be drawn up clear of the fish from the tail, and so enclose it entirely. If the gaff be used, the fish should be floated over it, and the gaff should never be thrust at the fish. The gaffing process is always a difficult one, and though an arduous task, I always prefer doing it myself, if possible. More fish are lost through the excited and awkward movements of the attendant with the net or gaff than from any other cause.

There is probably no fish more capricious in its feeding than this majestic fish. That is a truth which is seen equally from every point of view, and probably largely accounts for the charm of its capture. It has been noted by the experienced, however, that there are certain times when the salmon feed more generally than at others.

On days of fitful sunshine and many clouds of the cumulus kind; also, if the wind, from being cold and easterly, turns to the west or south, and becomes warmer; also, on windy days, after still and close weather, on rough days after fine weather, and often when there is a strong wind blowing, the *Salmo salar* takes the fly according to his humor.

The Theory of the Bass Fly

The making of the bass fly rests on a very slim foundation of theory. Most of the patterns which have been found successful in bass-fishing are without prototype in the natural insect. The gaudiest combinations are often used with effect; but I am bound from my own experience to conclude that the nearer the size and color approach those of the large family of the dragon-flies (*Libelullidæ*), the more productive will be the lure.

The small-mouthed black bass is as capricious as the salmon or trout in his choice of the artificial flies he will rise to. I have never seen the fish take any natural fly, save the dragon-fly, as it rises from the pseudo-imago to the imago state. At such times the imitation of the creature will

kill plentifully. A brown hackle dressed "buzz" — or with the hackle wound round the body — seems to be the nearest imitation one can tie, and in my experience it has been most successful. In early summer bass will also take most of the so-called "standard" flies; and there is no fly which is a passable imitation of a brown or yellowish brown insect which does not seem *caviare* to this fish at times.

I do not, therefore, reject "fancy" or "standard" flies, knowing as I do that the impetuous black bass has whims of his own which no one can account for or understand. It may be added that the wet-fly system is that usually in vogue with the bass fly-fisher, but a floating cork- or straw-bodied fly of the right color and size often does wonderful execution. In early summer, when the brownish dragon-flies rise in myriads into the air, it is impossible to do wrong if one imitates, howsoever roughly, the size, shape, and color of the larvæ. Speaking comprehensively, it may be assumed that the theories underlying trout and salmon fly-fishing are merged in the theory which explains the ready capture of the black bass on the gorgeous and sometimes composite flies in use, which, while not professing to be counterparts

of the living or natural insect, are equally not like the exquisite compositions of silk and feather, which so variously are employed to lure the salmon. The black bass fly in ordinary use seems to strike the mean between the trout and salmon fly.

The most successful bass flies are those that are made with a view to arousing the attention of the voracious fish by means of attractive colors, as well as those which resemble the tints of the natural food of the fish. No rule can, however, be positively given; and it is, after all, probable that the most successful angler for bass with the fly is he who keeps his lure moving and as far off as possible from himself, and who, when he finds one particular fly is not productive, industriously changes it until he finds the right one, — always with a view to the contrast between each succeeding fly.

The observant trout-angler will have no difficulty in applying his knowledge of the finer arts necessary for trout to the more strenuous methods of luring the robust black bass. I have never had any doubt that, size for size, the small-mouthed bass is the equal in fighting power to any of our game fish; but his frank and fierce bravery

is of a different kind to that from the *Salmonidæ*, and lacks somewhat in refinement and delicacy of bearing. Fundamentally, however, the theory of fly-tying for these fish is the same as that for trout, with the slight exceptions already noted.

The Making of the Bass Fly

In choosing the hooks for bass fly-tying I always prefer the Limerick O'Shaughnessy, and find that it saves the most fish, from the fact of its thickness and strength of wire, and its good qualities of bend. For the eyed hook, I choose the Pennell down-eyed, and find it satisfactory, its only fault, if fault it be, being that the point of the hook is bent round too near the shank for infallible engagement with the jaw of the bass. All numbers in the Limerick hook, from No. 6 to No. 1, are useful as occasion calls for them. They cannot be improved upon for the purpose under consideration.

It is hard to make a selection of bass flies when so many are proved to be killers according to the caprice of the fish. My experience, however, has led me to the choice, on the whole, of the following flies; and with these of sizes vary-

ing from No. 6 to No. 1, — the majority being of smaller sizes, — I do not fear failure on any waters where the bass will take a fly. And where they will do this, let it here be affirmed that, like salmon, they may be taught or educated to do so; for I have done this on several occasions.

Here is my list: —

1. Brown hackle. Body, peacock herl; hackle, brown rooster; tag, gold tinsel.

2. Deer-hair hackle. Body, yellow silk; hackle, gray-brown hair from deer, tied very securely and in plenty at the head.

3. Scarlet ibis. Body, scarlet silk, ribbed gold tinsel; tail, ibis and white swan; hackle, red ibis scapular feather.

4. Toodle bug. Body, yellow, tagged at the lower end with blue, and the body wound with a brown hackle halfway up to the throat of fly; wings, from dark brown turkey.

5. Grasshopper. Body, light brown wool or worsted; tail, barred wood-duck and yellow dyed swan; hackle, dark crimson; wings, jungle cock hackle feather, with strips of ibis and white swan over top of wings; head, green peacock herl, two turns.

6. Fiery brown. Body, a fiery brown wool or

PLATE 3

BROOK TROUT FLIES

1. BLACK GNAT
2. COACHMAN
3. WICKHAM'S FANCY
4. ROYAL COACHMAN
5. ALDER
6. GRANNOM
7. PROFESSOR
8. GRIZZLY KING
9. SILVER SEDGE
10. MAY FLY
11. FLIGHT'S FANCY
12. SAETOUN

J. HARRINGTON KEENE *fecit*


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mohair; hackle, brown; wings, red brown from feather of peacock; tail, ibis.

7. Coachman. Body, peacock herl; hackle, brown; wings, white swan; tag, gold tinsel.

8. Alder. Body, peacock herl; wings, brown mallard; hackle, dark brown.

9. Kingfisher. Body, scarlet silk, ribbed gold tinsel; hackle, Plymouth rooster; tail, tippet of golden pheasant; wings, dark barred mallard, from breast.

10. Lord Baltimore. Body, orange silk, ribbed black thread; tail, fibres crow; hackle, black; wings, black (crow) with jungle-cock sides.

11. Gray drake. Body, white silk, ribbed black thread; hackle, white; black setæ; wings, dark barred feather of pintail breast.

12. White miller. Body, hackle, and wings, white; gold tinsel at tag.

With these flies tied on good gut, doubled or reënforced for about two inches above the hook shank, and fished with skill, the angler need never fear lack of sport. Other flies will probably creep into his collection; but this list is the one which has gradually, through many years, come to be, for me, the inevitable "survival of the fittest."

Of course the trout fly-tier will find no practical

difficulty in making bass flies; they are ordinarily, and for the most part, simpler than the majority of trout flies. But one useful alternative has been in my method for the last fifteen years when it has been found undesirable to take a large number of flies, and may be explained as follows: *Imprimis*, I believe in having at least half a gross of such flies as are given above for any fishing trip where bass are the quarry. If the angler desires to economize, he may take twelve complete flies only, but by a simple arrangement of interchangeability he may, out of his one dozen flies, make 144 different flies at will. This may seem like a statement of legerdemain, but the explanation is very simple; to wit: —

I make a dozen flies of different kinds, — such as I have above given, — but in the bodies of each I tie a thin silver tube (such as jewellers use in their work) and fasten off the body with the end of the tube slightly protruding at the end and on the top of the shank, the gut snell being below on the under side of the shank. The whipping must be securely tied and varnished. The hackle and wings are tied on a stout common pin. I use one of the blue steel kind with a bead head. Be careful that the pin fits closely in the tube, and

that the whippings are well waxed and varnished. This is the process, and the "interchangeable fly" is made thus easily.

To render the fly complete, one has only to insert the pin in the tube, thrusting it tightly home to the head. The hackles are then smoothed out, and the fly appears at once exactly like any other fly. But observe the advantage of the arrangement! You have twelve separate flies, which may be used to their correct pattern if you choose; and you can vary these patterns twelve times each pattern, after you have tested the original twelve standards. Of course the same fly-making applies to other large flies. Even six standards, with their six standards, give three dozen separate and distinct variations; and the labor of making this interchangeable device is little greater than that incurred in making the ordinary one-piece bass fly.

One other variation in the making of the bass fly is very efficient in some circumstances. I refer to the enclosure, next the shank of the hook, of a piece of lead wire or foil, to render the fly a sinking lure. The black bass often objects to rise to the surface for his food, and this device carries the fly to mid-water, or thereabouts, where the fish does not hesitate to seize with avidity.

On the other hand the floating fly, as has been noted, must not be despised; for the fanciful bass never gives warning precisely when or how he prefers his meal at a given time.

Using the Bass Fly

Micropterus Dolomiei, being no fool, and like all ardent creatures, human and otherwise, is variable and hard to understand, as we have seen. Fly-fishing is, of course, the supreme method of his capture; and brief but practical directions for the use of the fly may here be ventured.

How to cast the fly. — Assuming that the bass-fisher is equipped as has been indicated, and that he is fishing running water, he advances toward the edge of the stream; and with the right or left foot forward, according to the side he is on, he stands facing downward and drops his flies in the running water. Holding the rod firmly grasped in the right hand, with the thumb uppermost, he draws a few feet of line from the reel with the left hand. A smart jerk of the rod draws out the loose line; and this is repeated with line drawn from the reel till some twenty feet are trailing in the water. Now let him raise the point of

the rod until the angle it assumes is about seventy degrees; then, with a swift and evenly increasing movement of the rod, he urges the line back over his head or left or right shoulder, according to the wind and necessity of the position, till the length of the line is expended behind him. This must be done with no jerk of the rod, but swiftly and forcefully, and with evenly increasing speed, till the psychological moment of extreme expenditure is reached, which will be felt on experiment after a few trials. When the line is thus extended, and, as it were, poised and about to fall to the earth behind — at that psychological moment the forward impulse must be made, and the rod brought forward swiftly and as evenly accelerating as before, to an angle of the rod and the water of forty degrees, or thereabouts. The result will be a clean cast, with the fly falling one imperceptible moment before the leader and the line. If, however, the aforesaid psychological moment be anticipated ever so little, the caster will hear a sharp snapping sound, and find that he has whipped off his fly. If it be missed, and the forward movement delayed, the cast will be a slovenly and ungraceful one, and quite unsatisfactory. It is a good plan to take a friend of sharp vision (and

some critical acumen) to tell you when the fly is extended behind. He should watch for its full extension and say, "Now!" on seeing it. The arm should not be waved, or allowed to extend from the side of the body; and some anglers find it well to place an object, such as a small book, between the elbow and the body to prevent this ungainly spreading of the arm. This is termed the "overhand cast," and is, of course, the basal cast of all others. In all practice the tyro should observe three cardinal principles; to wit: Never be in a hurry, never snatch or jerk the rod, and never forget that the rod and wrist are one mechanism for the time being, with the wrist as the propelling power which the rod magnifies and completes. A good rod should be pliant down to its extreme butt end, and the wrist is then the pivot on which it turns and does its perfect work, in which is the very poetry of resilient strength.

There are other methods of casting the fly which are useful for fishing in difficult waters. These are, briefly: the "wind" cast, the "underhand" cast, the "flip" cast, and the famous "switch" or Spey cast. The latter is especially useful, and indeed necessary, when an obstruction, such as an overhanging rock, is at the back of the angler. I have seen

a seventy-foot cast of the Spey kind made with a rock wall of a hundred feet rising within six feet of the angler and right at his back. The movement of the rod is one which cannot be exploited except at the water-side, and is one which cannot be taught on paper. The wind cast is a modified Spey cast, and the underhand is simply a side-drawn and side-cast line. The flip cast is made by taking the fly between thumb and finger (beware of the hook point!), bending the rod as a bow, holding a few coils of line in the fingers of the right hand which grasp the rod, and letting go of the fly suddenly in the direction required. This is especially useful when fishing under the overhanging boughs of side growth, by which some streams are fringed.

For the majority of purposes, however, a thoroughly practised ability with the overhand cast is sufficient for bass, it being the parent of all other methods, and proficiency with it rendering improvisation of other casts an easy task as the necessity arises. The learner should always remember that it is not the *long* cast which takes the prize, — though sometimes it is necessary to cast a long line; but it is the softly and accurately laid fly, which alights gently as thistledown

just before the eyes of the waiting bass, that always does the trick; and it is the man who keeps his lure longest in the water who catches the most bass.

One important remark must be added to the above: As the bass is not a top-water feeder, it is sometimes well to let the fly sink a foot or so beneath the surface; and it should be slowly recovered, so that the tackle may not be injured by too precipitate a movement. In fly-fishing for trout one must not be slow, the trout being a top-water feeder and superbly developed to that end.

The leader for bass fly-fishing is composed of silkworm gut, of thickness and strength appropriate to the probable size of the fish in view. Where the bass run up to two pounds and over, a salmon gut is necessary; and each strand should be tested up to at least five pounds dead weight. It should be at least six feet in length, and be looped at both ends, with one or two other loops at a distance of twenty inches apart along it. The upper loop is for attachment to the reel line, and the lower ones are for the two or three flies which may be chosen. Before using, — no matter how impatient the angler may be, — he should soak

DETERMINED TO GET SOMETHING.

the leader for at least fifteen minutes in water. This softens the gut at the knots, and prevents fracture from the sudden strain of a fish. The experienced angler well knows that he has lost many fish at the first cast because this precaution has been omitted. I do not recommend the tapered leader for bass — no chain is stronger than its weakest link.

The reel for bass fly-fishing should be of reliable make, and need not be multiplying if the barrel be of large diameter. It should be of the check or click pattern, so that, in casting, the line should not over-run. Its capacity should not be less than 150 feet of line of moderate gauge.

The line for bass-fishing should be of the finest grade, braided, and may vary according to the methods of the angler from a threadlike fineness to half the thickness of a straw. Some anglers need stronger tackle than others, — it is a matter of temperament. For *fly*-fishing the line should be enamelled, but for bait-fishing the expensive enamel is not so necessary, and the old dressings of oil and varnish will serve. Lines are now so beautifully and cheaply prepared that it is little profit to dress them at home. The rod for bass fly-fishing should not be more than ten feet long

and of proportionate weight, to suit the strength and endurance of the angler. No rod should be of a weight which unduly fatigues the angler, for in a good day's bass-fishing his natural strength is likely to be tested to the limit by this bold, strong fish. A sectioned bamboo rod, hand-made, of course, and weighing about seven ounces at most, is recommended as of reasonable weight and resiliency for the man of average physical powers.

INDEX

THE SHOT-GUN AND ITS HANDLING, 1-114

THE HUNTING RIFLE, 115–187

THE THEORY OF RIFLE-SHOOTING, 189–256

THE PISTOL AND REVOLVER, 257–355

THE ARTIFICIAL FLY, 357–426